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An Evaluation of the Compatibility and Uniformity of State Regulations for the Control of Radiation

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ORO 70-8	Model Legislation for Users of Ionizing Radiation in the Healing Arts	

BRH/ORO 70-7

An Evaluation of the Compatibility and Uniformity of State Regulations for the Control of Radiation

(As of 1969)

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November 1970

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
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FOREWORD

This report is one of a series of eight Bureau of Radiological Health staff documents used in the preparation of the "Report to the Congress on Studies Conducted Pursuant to Section 357 of the Radiation Control for Health and Safety Act of 1968, Public Law 90-602." A number of projects were established to study and report on various aspects of radiation control.

The Bureau of Radiological Health, formerly the National Center for Radiological Health, carries out a continuing national program designed to reduce the exposure of man to hazardous ionizing and nonionizing radiation.

The Bureau publishes its findings monthly in Radiological Health Data and Reports, Public Health Service numbered publications, appropriate scientific journals, and technical report series for the Bureau's divisions, offices, and laboratories.

The technical reports series allows comprehensive and rapid publishing of the results of intramural and contractor projects. The reports are distributed to State and local radiological health program personnel, Bureau technical staff, Bureau advisory committee members, university radiation safety officers, libraries and information services, industry, hospitals, laboratories, schools, the press, and other interested individuals. These reports are also included in the collections of the Library of Congress and the National Technical Information Service.

I encourage the readers of these reports to inform the Bureau of any omissions or errors. Your additional comments or requests for further information are also solicited.

John C. Villforth

John C. Villforth
Director
Bureau of Radiological Health

PREFACE

This report on an evaluation of State regulations for the control of radiation was prepared in partial fulfillment of the requirements of Section 357, Public Law 90-602, The Radiation Control for Health and Safety Act of 1968.

Section 357 of the Act requires certain studies be conducted including the determination of any gaps and inconsistencies that may exist in State control of health hazards from radiation.

A major factor in establishing and maintaining a regulatory control program is the promulgation and the periodic updating of regulations. It is also important in establishing nationwide consistency of control efforts to provide for compatibility with other States and the Federal government in radiation control.

For purposes of this study, the 1966 amended version of the Council of State Governments' Suggested State Regulations for Control of Radiation was utilized. Since this study was conducted, several States have updated their regulations and a revised edition of the model regulations has been distributed.

James W. Miller

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ABSTRACT

A comparative study was made of State regulations for the control of sources of ionizing radiation with the Council of State Governments' suggested regulations. This report presents the findings of this study including completeness of regulations, compatibility with the model and whether the regulations were up to date.

AN EVALUATION OF THE COMPATIBILITY AND UNIFORMITY OF STATE REGULATIONS FOR THE CONTROL OF RADIATION

INTRODUCTION

The National Advisory Committee on Radiation in its report to the Surgeon General in 1962 indicated that a radiation protection program at any level of government must incorporate clear responsibility and authority for its applications in well-defined terms. The legal and professional responsibilities of local and State agencies, the extent of their resources, and their role in matters affecting health are factors which should be taken into account by all who are concerned with the practical aspects of controlling hazards from radiation.

The development of adequate regulations for controlling any hazard is dependent upon the presence of standards which are adequate and accepted by people knowledgeable in the field. In the case of ionizing radiation, these standards have been developed through the years first by the International Commission on Radiological Protection (ICRP) and the United States National Council on Radiation Protection and Measurements (NCRP).

The ICRP was formed in 1928 under the auspices of the International Congress of Radiology. The NCRP, initially organized as an advisory committee on X-ray and radium protection, was composed initially of members of the medical societies and X-ray equipment manufacturers and the National Bureau of Standards. This committee was reorganized in 1946 and has been instrumental in the development and publishing of applicable recommendations for the protection against radiation.

The recommendations developed by the NCRP have utilized the most current knowledge about both the somatic and genetic effects of radiation. As greater knowledge of the biological effects of ionizing radiation became known, the regulatory standards have reflected this new knowledge. The occupational exposure limits can serve as an example. During the

30-year period from 1931 through 1960, the occupational exposure limit was reduced from 60 rem per year in 1931, to 5 rem per year at the present time. The occupational quarterly exposure limit was reduced from 3 rem in 1961, to 1-1/4 rem for those workers on whom lifetime dose records are not kept.

State governments have the traditional and constitutional responsibility for the public health, safety, and welfare of their own people. In the field of radiation it is particularly true that the States have the responsibility to protect their people from the adverse effects of the use of radiation in those areas such as radiation producing machines and naturally occurring radioactive materials, which are not within the purview of the Atomic Energy Act.

In 1959, an amendment to the Atomic Energy Act provided for State assumption of Federal regulatory authority. By March 1, 1969, 19 States had assumed this authority by signing an agreement with the Atomic Energy Commission. With passage of this amendment, it was apparent that a need existed for insuring that States develop and maintain programs compatible with each other and with the Federal program. To provide a mechanism by which this might be accomplished, the Council of State Governments, with the cooperation and assistance of interested agencies, published a model State radiation control act and suggested model State regulations for control of radiation.

One of the most important features of establishing and maintaining a comprehensive State radiological health program is the promulgation and periodic updating of regulations reflecting the most current information. To meet this need, the Council of State Governments, the Atomic Energy Commission, and the Public Health Service, with participation by individual States, revised and amended the suggested State regulations in 1964 and again in 1966. These revisions incorporate changes and additions (1) to conform to amendments to Atomic Energy Commission regulations, (2) to clarify the intended meaning of certain sections, and (3) to maintain consistency with latest information and authoritative recommendations.

Assistance and encouragement to State agencies in developing comprehensive radiological health programs that are compatible with each other and with the Federal effort is an important part of the Bureau of Radiological Health's objective of protecting the nation's population from unnecessary radiation. An important step in developing an adequate State program, and one of the first items to be undertaken, is the promulgation of regulations by which radiation hazards can be controlled in a manner compatible with controls instituted by other States and the Federal government.

This study was undertaken in an effort to determine:

1. Whether State agencies have provided complete regulations for controlling the various areas requiring control.

2. Whether the States have utilized the model regulations in order to provide compatibility with other States and the Federal government in radiation control.

3. Whether the States have maintained their regulations current with new knowledge and needs related to radiation control.

METHODOLOGY

For purposes of this study, the Council of State Governments' Suggested State Regulations for Control of Radiation, October 1964, as amended 1966 was utilized as a model against which each State's regulations, in force March 1, 1969, were compared. This comparison, on a selected section-by-section basis, yielded information on whether the appropriate sections of the individual State regulations were present, absent, or deviated from the suggested model. All sections believed to be significant in controlling hazards from radiation were selected for comparisons by total States and by geographic areas as shown in tables 1 through 14.

FINDINGS

By March 1, 1969, 47 States out of a potential 53, including Puerto Rico, the Virgin Islands, and the District of Columbia, has passed enabling legislation to permit the control of ionizing radiation within their jurisdictions. Fifty-one of these jurisdictions prohibit or regulate the use of shoe-fitting fluoroscopes either by legislation or regulation. In addition, three States adopted legislation requiring the registration of laser devices, and two additional States have obtained specific authorization to regulate all sources of nonionizing electronic products.

Between January 1966 and March 1, 1969, a total of 26 States adopted new regulations for the control of radiation or amended their existing regulations. These regulations have been patterned, to a greater or lesser degree, after the suggested model regulations.

By March 1969, a total of 19 States, Alabama, Arizona, Arkansas, California, Colorado, Florida, Idaho, Kansas, Kentucky, Louisiana, Mississippi, Nebraska, New Hampshire, New York, North Carolina, Oregon, Tennessee, Texas, and Washington had assumed certain regulatory responsibilities for the control of radioactive materials from the Atomic Energy Commission pursuant to Public Law 86-373. These States have all promulgated regulations for the control of radioactive materials comparable to the model regulations, and as of March 1, 1969, all but two of these States had comparable regulations for controlling X-rays and other machine-produced radiation.

Considerable variations were observed among the State regulations in providing specific control features similar to the suggested model. Provisions for licensing and other controls over radioactive material are shown in tables 1, 2, and 3. These indicate that while 21 States provide general requirements for licensing of radioactive material, only 18 States provide the model provisions for reciprocal recognition of licenses issued by another jurisdiction. It is shown in table 2 that 20 States specifically provide regulations for television receivers, while 22 States provide regulations for any electrical equipment emitting ionizing radiation above a specified level. Table 4 shows that 25 States regulate the exposure of individuals to radiation, whereas only 16 States (table 5) require notification and decontamination of premises being vacated as shown in section C 407 of the Suggested State Regulations for Control of Radiation which could affect future exposure of individuals. Table 6 indicates that 23 States, possessing regulations covering industrial radiography, have followed the model provisions.

Similar variations are observed in State regulations controlling the use of radiation in the healing arts as shown in tables 7 and 8. It is interesting to note in table 8 that while 25 States provide regulations for restricting the useful beam in radiographic installations, only 12 States utilized provisions similar to those found in the appropriate section [E.4(a)(4)], of the model regulations.

The States were grouped by geographic area, as defined by the 1960 census, to determine what effect location and the combination of various parameters unique to a particular region would have on the maintenance of current regulations similar to the suggested model. States encompassed by each specific geographic area are given below:

Northeast Area: Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Pennsylvania, Rhode Island, and Vermont.

North Central Area: Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, Ohio, South Dakota, and Wisconsin.

Southern Area: Alabama, Arkansas, Delaware, District of Columbia, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, Puerto Rico, and the Virgin Islands.

Western Area: Alaska, Arizona, California, Colorado, Hawaii, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

Selected sections of the model regulations and the number of States located in each geographic area that have similar regulations as of March 1, 1969, are presented in tables 9 through 14. It is interesting to note that States located in the Western and Southern areas generally follow the provisions of the model regulations throughout, while States in the other regions exhibit considerable variation from the various provisions. The Western and Southern regions also contain the greatest percentage of AEC Agreement States. The factors that may be influential in establishing this level of activity were beyond the scope of this study. An in-depth study should be undertaken in this area to determine what information and parameters might be utilized by other regions in the upgrading and maintenance of radiation control regulations.

The 19 Agreement States presently exert control over sources of ionizing radiation for approximately 47 percent of the nation's population. An additional six States possess regulations generally in agreement with the model regulations. These States, together with the Atomic Energy Commission Agreement States, provide regulatory control for some 59 percent of the total national population.

The 19 Atomic Energy Commission Agreement States represent:

22 percent of the 9 States located in the NOrtheast region;

16.6 percent of the 12 North Central States;

47.4 percent of the 19 Southern States; and

46 percent of the 13 Western States.

From the above, it appears that the Southern and Western States have demonstrated an interest and concern about radiation control to a much greater degree than have the States located in other areas of the country. In signing an agreement with the AEC, each State must promulgate and maintain current regulations as part of the required conduction of a radiation control program compatible with the AEC and with other Agreement States. It is also apparent that some of those States in regions noted for their industrial development or as population centers have not been among the States developing comprehensive regulations required for attaining AEC agreement status.

Since March 1, 1969, several States have promulgated additional regulations appropriate to this study. These States and the respective effective date of their regulations are as follows:

Georgia	March 11, 1969
South Carolina	March 31, 1969
Texas	March 11, 1969
Florida	July 7, 1969
Oklahoma	April 1, 1969
Ohio	July 1, 1969

Time did not permit these later regulations to be compared to the suggested model.

In response to a questionnaire, most of the States have indicated a need, as shown in table 15, for assistance in developing additional model regulations that could cover accelerators, nonmedical X-ray equipment, and nonionizing sources of radiation.

CONCLUSIONS

Passage of enabling legislation by a State does not necessarily mean that a State agency will promulgate or maintain up-to-date regulations to implement this authority.

Approximately 50 percent of the States possess similar regulations to the 1966 amended model regulations, which are compatible with each other, and provide for a control program affecting almost 60 percent of the nation's population.

Outside stimulation, such as becoming an AEC AGreement State, appears to provide additional motivation in providing regulations for the control of machine-produced radiation as well as radioactive material.

Passage of Public Law 90-602 by the United States Congress and the States' recognition of their responsibilities in the electronic product radiation areas have led to the introduction of enabling legislation for the control of nonionizing radiation by several State governments.

Approximately 50 percent of the States have not indicated a concern or an awareness of the need for establishing comprehensive regulations or of the need for maintaining compatibility with other States as a means of effecting nationwide control over the hazards from radiation.

Table 1. States having specific licenses as of March 1, 1969

	General requirements for issuance of specific license B.25	Special requirements for issuance of specific license for radioactive materials B.26	Transfer of material B.40	Modification revocation and termination of license B.50	Reciprocal recognition of license B.90	General license, labeling requirement B.22
Comparable to model	21 (39.6)	20 (37.7)	20 (37.7)	21 (39.6)	18 (34)	18 (34)
Differs from model	0	0	0	0	1 (1.9)	3 (5.7)
No provisions	32 (60.4)	33 (62.3)	33 (62.3)	32 (60.4)	34 (64.1)	32 (60.4)

NOTE: Numbers in parentheses indicate percentage of 53 States.
Numbers underlined indicate appropriate section of Suggested Model Regulations, as amended 1966.

Table 2. States providing for exemptions from license as of March 1, 1969

	Source material B.3	Radioactive materials			Other exemptions		
		Concentration equal to or less than listed schedule B.4(a)	Luminous timepiece B.4(b)	Lock illuminator B.4(c)	Carriers B.5	Domestic television receivers B.6(a)	Other electrical producing radiation B.6(b)
Comparable to model	21 (39.6)	21 (39.6)	20 (37.7)	18 (34)	25 (47.2)	20 (37.7)	22 (41.5)
Differs from model	0	2 (3.8)	8 (15.1)	5 (9.4)	0	0	0
No provisions	32 (60.4)	30 (56.6)	25 (47.2)	30 (56.6)	28 (52.8)	33 (62.3)	31 (58.5)

NOTE: Numbers in parentheses indicate percentage of 53 States.
Numbers underlined indicate appropriate section of Suggested Model Regulations, as amended 1966.

Table 3. States having precautionary procedures as of March 1, 1969

	Caution signs - labels and signals				States regulating waste disposal			
	Personnel monitoring C.202	Radiation areas C.203(b)	Containers C.203(f)	Storage of sources C.206	General requirements C.301	Release into sanitary sewage system C.303	Disposal by burial in soil C.304	Disposal by incineration C.305
Comparable to model	27 (50.9)	28 (52.8)	25 (47.2)	27 (50.9)	23 (43.4)	25 (47.2)	24 (45.3)	24 (45.3)
Differs from model	2 (3.8)	0	3 (5.6)	0	0	2 (3.8)	3 (5.7)	0
No provisions	24 (45.3)	25 (47.2)	25 (47.2)	26 (49.1)	30 (56.6)	26 (49.0)	26 (49.0)	29 (54.7)

NOTE: Numbers in parentheses indicate percentage of 53 States.
Numbers underlined indicate appropriate section of Suggested Model Regulations, as amended 1966.

Table 4. States regulating permissible doses, levels, and concentrations as of March 1, 1969

	Exposure of individuals to radiation in restricted areas C.101	Determination of accumulated dose C.102	Airborne radioactive material specified conc. limits C.103	Exposure of minors C.104	Permissible levels; external sources; unrestricted areas C.105	Concentration in effluents; unrestricted areas C.106	Bioassay service requirement C.107
Comparable to model	25 (47.2)	23 (43.4)	26 (49.1)	24 (45.3)	25 (47.2)	22 (41.5)	21 (39.6)
Differs from model	3 (5.6)	0	1 (1.8)	2 (3.8)	3 (5.6)	2 (3.8)	0
No provisions	25 (47.2)	30 (56.6)	26 (49.1)	27 (50.9)	25 (47.2)	29 (54.7)	32 (60.4)

NOTE: Numbers in parentheses indicate percentage of 53 States.
Numbers underlined indicate appropriate section of Suggested Model Regulations, as amended 1966.

Table 5. States requiring records, reports, and notification as of March 1, 1969

	Authority to require:						
	Maintenance of records B.70	Agency inspections B.71	Records on surveys and radiation monitoring and disposal C.401	Reports of theft or loss of radiation sources C.402	Notification of incidents C.403	Reports on radiation exposure to former employees and others C.404	Vacating premises C.407
Comparable to model	26 (49.1)	26 (49.1)	28 (52.8)	27 (50.9)	24 (45.3)	25 (47.2)	16 (30.2)
Differs from model	0	0	1 (1.9)	1 (1.9)	4 (7.5)	0	0
No provisions	27 (50.9)	27 (50.9)	24 (45.3)	25 (47.2)	25 (47.2)	28 (52.8)	37 (69.8)

NOTE: Numbers in parentheses indicate percentage of 53 States.
Numbers underlined indicate appropriate section of Suggested Model Regulations, as amended 1966.

Table 6. States providing regulation of industrial radiography as of March 1, 1969

	Operations							Personnel qualifications			
	Limits on levels of radiation[a] D.101	Locking of radiation sources D.102	Storage precautions D.103	Radiation survey instruments D.104	Periodic leak-test of sealed sources D.105	Quarterly inventory D.106	Utilization logs D.107	Limitations D.201	Operating and emergency procedures D.202	Personnel monitoring control D.203	Radiation surveys and survey records D.303
Comparable to model	22 (41.5)	23 43.4)	24 (45.3)	23 (43.4)	22 (41.5)	23 (43.4)	23 (43.4)	23 (43.4)	23 (43.4)	23 (43.4)	23 (43.4)
Differs from model	1 (1.9)	1 (1.9)	0	0	2 (3.8)	0	0	0	0	0	0
No provisions	30 (56.6)	29 (54.7)	29 (54.7)	30 (56.6)	29 (54.7)	30 (56.6)	30 (56.6)	30 (56.6)	30 (56.6)	30 (56.6)	30 (56.6)

[a] Includes radiographic devices and storage containers.

NOTE: Numbers in parentheses indicate percentage of 53 States.
Numbers underlined indicate appropriate section of Suggested Model Regulations, as amended 1966.

Table 7. States providing general safety provisions in healing arts as of March 1, 1969

	Responsibility for equipment statement E.3(a)	Use: Registrants' responsibilities E.3(b)	Shielding requirements E.3(c)
Comparable to model	21 (39.6)	22 (41.5)	18 (34)
Differs from model	2 (3.8)	0	2 (3.8)
No provisions	30 (56.6)	31 (58.5)	33 (62.2)

NOTE: Numbers in parentheses indicate percentage of 53 States.
Numbers underlined indicate appropriate section of Suggested Model Regulations, as amended 1966.

Table 8. States providing regulations for X-ray installations as of March 1, 1969

	Fluoroscopic	Radiographic	Mobile radiographic		Dental radiographic	Veterinary	Therapeutic		
	Attenuation of useful beam E.4(a)(4)	Restricting useful beam E.5(a)(2)	Equipment requirements E.6(a)	Personnel monitoring E.6(c)(2)	Restricting useful beam E.7(a)(2)	Operating procedures E.10(c)	Collimating useful beam E.8(a)(2)	Control panel dedevice (to indicate production of X-rays E.8(a)(9)	Interlocks E.8(b)(5)
Comparable to model	12 (24.5)	25 (49.1)	23 (45.3)	21 (41.5)	24 (47.2)	20 (39.6)	26 (49.1)	22 (41.5)	24 (45.3)
Differs from model	13 (24.5)	0	2 (3.8)	0	1 (1.9)	2 (3.8)	0	0	1 (1.9)
No provisions	28 (51)	28 (50.9)	28 (50.9)	32 (58.5)	28 (50.9)	31 (56.6)	27 (50.9)	31 (58.5)	28 (52.8)

NOTE: Numbers in parentheses indicate percentage of 53 States.
Numbers underlined indicate appropriate section of Suggested Model Regulations, as amended 1966.

Table 9. Selected items in the specific licenses and registrations of machines sections by geographic areas[a]

	Specific licenses section			Registration of machines section	
	Specific requirements for issuance; radioactive materials	Transfer of material controlled	Reciprocal recognition of license	Specific time period for notification	Change of status notification
Northeast:					
Comparable to model	2	2	1	2	2
Differs from model	0	0	1	4	5
No provisions	7	7	7	3	2
North Central:					
Comparable to model	3	3	4	5	4
Differs from model	0	0	0	1	1
No provisions	9	9	8	6	7
South:					
Comparable to model	9	9	8	9	9
Differs from model	0	0	0	0	0
No provisions	10	10	11	10	10
West:					
Comparable to model	6	5	6	6	6
Differs from model	0	0	0	0	0
No provisions	7	8	7	7	7

[a] Fifty-three States included.

Table 10. Selected items in the exemptions section by geographic areas[a]

	Radioactive materials		Other exemptions	
	Concentrations listed schedule	Luminous time-pieces	Domestic television receivers	Other electrical equipment producing radiation
Northeast:				
Comparable to model	3	4	4	5
Differs from model	2	3	0	0
No provisions	4	2	5	4
North Central:				
Comparable to model	3	3	3	3
Differs from model	0	2	0	0
No provisions	9	7	9	9
South:				
Comparable to model	9	7	8	9
Differs from model	0	3	0	0
No provisions	10	9	11	10
West:				
Comparable to model	6	6	5	5
Differs from model	0	0	0	0
No provisions	7	7	8	8

[a] Fifty-three States included.

Table 11. Selected items in the permissible doses, levels, and concentrations sections and precautionary procedures required by geographic areas[a]

	Exposure of individuals in restricted areas	Permissible levels from external sources; unrestricted areas	Concentration in effluents to unrestricted areas	Personnel monitoring	Caution signs, labels, and signals		
					Radiation areas	High-radiation areas	Containers
Northeast:							
Comparable to model	5	4	3	6	7	7	5
Differs from model	2	3	1	1	0	0	2
No provisions	2	2	5	2	2	2	2
North Central:							
Comparable to model	6	6	4	4	5	5	4
Differs from model	0	0	0	1	0	0	1
No provisions	6	6	8	7	7	7	7
South:							
Comparable to model	9	10	9	10	10	10	10
Differs from model	1	0	1	0	0	0	0
No provisions	9	9	9	9	9	9	9
West:							
Comparable to model	6	6	6	6	6	6	6
Differs from model	0	0	0	0	0	0	0
No provisions	7	7	7	7	7	7	7

[a] Fifty-three States included.

Table 12. Records, inspections, tests, and notification required by geographic areas[a]

	Records maintained	Inspections permitted	Special tests required	Notification of incidents	Notification of vacating premises
Northeast:					
Comparable to model	7	7	7	4	1
Differs from model	0	0	0	3	0
No provisions	2	2	2	2	8
North Central:					
Comparable to model	4	6	5	4	3
Differs from model	0	0	0	1	0
No provisions	8	6	7	7	9
South:					
Comparable to model	9	9	9	10	6
Differs from model	0	0	0	0	0
No provisions	10	10	10	9	13
West:					
Comparable to model	6	5	5	6	6
Differs from model	0	0	0	0	0
No provisions	7	8	8	7	7

[a] Fifty-three States included.

Table 13. Selected items in industrial radiography by geographic areas[a]

	Maintenance of utilization logs	Written operating and emergency procedures
Northeast:		
Comparable to model	3	3
Differs from model	0	0
No provisions	6	6
North Central:		
Comparable to model	4	4
Differs from model	0	0
No provisions	8	8
South:		
Comparable to model	10	10
Differs from model	0	0
No provisions	9	9
West:		
Comparable to model	6	6
Differs from model	0	0
No provisions	7	7

[a] Fifty -three States included.

Table 14. Selected items in X-ray: Healing arts section by geographic areas[a]

	Shielding requirements	Prohibited use	Fluoroscopic attenuation of useful beam	Radiographic restricting useful beam	Mobile radiographic equipment requirement	Dental restricting useful beam	Therapeutic control panel device to indicate production of X-ray	Therapeutic interlocks required
Northeast:								
Comparable to model	2	1	2	6	5	5	3	6
Differs from model	1	1	4	0	1	1	0	0
No provisions	6	7	3	3	3	3	6	3
North Central:								
Comparable to model	4	3	3	6	5	6	6	5
Differs from model	0	0	3	0	0	0	0	1
No provisions	8	9	6	6	7	6	6	6
South:								
Comparable to model	5	4	3	7	7	7	7	6
Differs from model	1	0	4	0	1	0	0	0
No provisions	13	15	12	12	11	12	12	13
West:								
Comparable to model	6	3	4	6	6	6	5	6
Differs from model	0	0	2	0	0	0	0	0
No provisions	7	10	7	7	7	7	8	7

[a] Fifty-three States included.

Table 15. Number of States indicating a need for additional specific model regulations for radiation sources

Type of source	Number of States[a] Model regulations needed
Accelerators	42
Nonmedical X-ray equipment	41
Nonionizing radiation sources	50

[a] Fifty-three States included.

APPENDIX A

SUGGESTED STATE REGULATIONS FOR CONTROL OF RADIATION

October 1964

(As Amended April 1966)

THE COUNCIL OF STATE GOVERNMENTS
1313 East Sixtieth Street
Chicago, Illinois 60637

PREFACE

Each year the Committee of State Officials on Suggested State Legislation prepares draft bills, statements and recommendations relating to a wide variety of matters which are of interest to the states. These proposals are presented to the states by the Council of State Governments through an annual publication, Suggested State Legislation. The Council's Committee on Suggested State Legislation is composed entirely of state officials - Commissioners on Interstate Cooperation, Commissioners on Uniform State Laws, Attorneys General, legislators and legislative officials.

The Committee has included in its Programs of Suggested State Legislation for 1957, 1959, 1960, and 1961, and in a Supplement to Suggested State Legislation - Program for 1959, legislative proposals and statements relating to various aspects of development and regulation of sources of ionizing radiation. In its Program for 1961, the Committee presented for consideration the State Radiation Control Act. Subsequently the Council published in a Supplement to the Program for 1961 all the Committee's current proposals on this subject.

While the State Radiation Control Act provides the legislative authority for a state radiation control program, many state officials felt that more detailed assistance would be desirable in view of the statutory requirement that a state program for regulation of atomic energy materials be compatible with the program of the Atomic Energy Commission. The desirability of compatible regulatory programs between and among the states was also recognized. Accordingly, the Council of State Governments, the Atomic Energy Commission, and the Public Health Service prepared a draft of proposed Suggested State Regulations for Control of Radiation to implement state radiation control acts. These were distributed widely among public officials and private persons. The resulting comments were taken into consideration in preparing the suggested regulations which were first published in September 1962. The regulations provide for regulation of all sources of radiation in that they are not only designed to incorporate provisions necessary to qualify a state to assume certain of the regulatory responsibilities of the Atomic Energy Commission pursuant to Public Law 86-373, but also to provide for regulation of sources of radiation over which there has never been federal jurisdiction.

This revised version (October 1964) of the Suggested State Regulations for Control of Radiation incorporates changes and additions, (1) to conform to amendments to AEC regulations, (2) to clarify or improve the language of certain sections, and (3) to correct a number of typographical and similar nonsubstantive errors. In the future, annual supplements will be issued to reflect changes in state and federal regulatory programs.

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INTRODUCTION
(September 1962)

Background

The Atomic Energy Act of 1954 added impetus to the private development of atomic energy for peaceful purposes. The development of peaceful uses of atomic energy, under the direction of the U.S. Atomic Energy Commission, focused public attention on many problems relating to this new and budding industry. Along with the benefits of this technological advance came the realization that many products, such as X-ray machines, long in public use, created problems similar to those associated with the new atomic industry. Widespread interest in radiation protection led eventually to the enactment of Public Law 86-373. The Commission worked closely with the Council of State Governments and many state officials in developing P.L. 86-373. This law permits individual states to assume regulatory responsibility over source, byproduct and certain special nuclear materials which had previously been subject solely to the jurisdiction of the Atomic Energy Commission. An agreement between the Governor and the Atomic Energy Commission is the means by which the transfer of authority takes place. Prior to entering such an agreement, the Governor must certify that the state has a program adequate to protect the public health and safety, and the Commission must find that the state regulatory program is compatible with its program and is adequate to protect the public health and safety.

The enactment of P.L. 86-373 initiated a series of efforts designed to insure success of the federal-state program. The AEC requested that the Council of State Governments convene small regional meetings of state officials to review a draft of proposed criteria for a state program that would meet the requirements of the new law. The criteria were published in the Federal Register on March 24, 1961. At the same time a committee of the National Association of Attorneys General and a subcommittee of the Committee of State Officials on Suggested State Legislation began drafting a suggested State Radiation Control Act.

The group of state officials decided that any suggested state legislation should provide for the regulation of all sources of radiation and should not be limited to those materials covered by P.L. 86-373. Drafts of the suggested act were reviewed by numerous state officials, representatives of the AEC and the U.S. Public Health Service, the American Municipal Association and representatives of labor and industry. The suggested State Radiation Control Act appeared in Suggested State Legislation - Program for 1961 published by the Council of State Governments.

While the suggested act provides the legislative authority for a state radiation control program, many state officials felt that more detailed assistance would be desirable. Two reasons were responsible for this desire. First, the statutory requirement that a state program, as it relates to those radiation sources subject to AEC regulation, must be "compatible" with the AEC program. Second, state officials recognized that in view of the nature of the subject matter involved, individual state regulatory programs must be similar to those adopted by their sister states. Accordingly, the Council of State Governments, the Atomic Energy Commission and the Public Health Service undertook the task of preparing a draft of proposed regulations that would implement a state radiation control act.

The draft regulations were distributed widely to public officials and private persons for comment. A revised draft and a summary of the comments were presented to the Advisory Committee of State Officials of the Atomic Energy Commission. After extensive discussion, the Committee appointed a subcommittee to confer with representatives of the Atomic Energy Commission, the Public Health Service and the Council of State Governments on the final version of the proposed regulations. The Suggested State Regulations for Control of Radiation present, in one degree or another, the considered view of the numerous individuals who participated in the above process.

Before turning to the regulations, several policy questions should be considered. As indicated above, the suggested State Radiation Control Act provides enabling legislation for state regulation of byproduct, source and certain special nuclear materials as well as X-rays and other sources of radiation not subject to AEC regulatory authority. The policy decision of the Committee of State Officials on Suggested State Legislation to draft suggested legislation which includes sources of radiation not regulated by the Commission was adhered to in developing the proposed regulations. This does not mean that the proposed regulations may be of assistance only to those states that plan to develop an overall radiation control program. The regulations will also be of assistance to those states which desire to regulate only those sources of radiation not subject to AEC regulation.

Parts A, B, C, and D of the regulations are modeled after applicable AEC regulations as they appear in Title 10 of the Code of Federal Regulations. This approach was followed for several reasons:

1. It was felt that the model regulations would be of greatest value if they were made available as soon as possible. Modifying an existing set of regulations to meet the needs of the states was the easiest way of achieving this goal.

2. In the interest of encouraging uniformity between state and federal regulatory programs for like materials, it was deemed desirable to pattern the suggested regulations after existing AEC regulations. Such uniformity is of particular importance to licensees whose programs may be subject in part to state regulations and in part to federal regulations or whose operations extend to several different states.

3. Since AEC regulations have proven adequate in practice over an extended period of time, it seemed appropriate to suggest incorporation of similar regulations by states.

4. It was thought that since a large part of the nuclear industry was familiar with the Atomic Energy Commission's program, the transition from federal to state regulation would be more readily made.

Parts E and F of the regulations are modeled after recommendations of the National Committee on Radiation Protection and Measurements as embodied in National Bureau of Standards Handbook 73, "Protection Against Radiations from Sealed Gamma Sources" and Handbook 76, "Medical X-ray Protection Up To Three Million Volts."

These model regulations were developed jointly by the Atomic Energy Commission, the Public Health Service, and the Council of State Governments. All three groups stand ready to give whatever assistance may be requested by the states in modifying these, or developing other regulations to meet the needs of the particular state.

Applications to State Programs

These Suggested State Regulations for Control of Radiation require the licensing of all radioactive materials and the registration of all other sources of ionizing radiation. It is realized that some states may wish to adopt a regulatory program which differs from this approach; e.g., a state may wish to license only agreement materials and register all other sources of ionizing radiation. Other regulatory systems can be accommodated by revision of these suggested regulations. However, it is suggested that care be exercised in the review and modification.

Two types of footnotes are used through these regulations. Footnotes which are designated by numbers are intended to be a part of the regulations. Footnotes which are designated by asterisk(s) are intended to assist states in drafting their regulations, and should not be incorporated as part of such regulations.

The regulations also contain expressions which have been set off by brackets. The bracketed portions contain either optional provisions, or are used to specify those places where states may wish to insert appropriate provisions.

OCTOBER 1964 REVISION

This revised version (October 1964) of the Suggested State Regulations for Control of Radiation incorporates changes and additions (1) to conform to amendments to AEC regulations, (2) to clarify or improve the language of certain sections, and (3) to correct a number of typographical and similar nonsubstantive errors. The following new or amended sections merit brief explanations.

Section B.3(c)(5) conforms to an amendment of the AEC regulations which changed the exemption for uranium contained in aircraft counterweights to uranium contained in counterweights for aircraft, rockets, projectiles or missiles.

Exemptions for thorium contained in finished optical lenses and for uranium contained in fire detection units have been added to Section B.3 to conform to new exemptions in the AEC regulations.

General Licenses for americium 241 and plutonium calibration sources have been added to Section B.22(e) to conform to new general licenses in the AEC regulations.

Sections B.4 and B.26(h) have been revised, and former Section B.31(d) has been deleted to conform to an amendment of the AEC regulations concerning the manufacture and distribution of products containing exempt concentrations of radioactive material. This amendment contains no change in technical specifications but provides for the introduction of exempt concentrations by consultant organizations as well as by manufacturers of products.

PART A

GENERAL PROVISIONS

Sec. A.1 Scope. Except as otherwise specifically provided, these regulations apply to all persons who receive, possess, use, transfer, own, or acquire any source of radiation; provided, however, that nothing in these regulations shall apply to any person to the extent such person is subject to regulation by the U.S. Atomic Energy Commission. Nothing in Part C of these regulations shall be interpreted as limiting the intentional exposure of patients to radiation for the purpose of diagnosis or therapy. 1/

Sec. A.2 Definitions.

(a) As used in these regulations:
    (1) "Act" means [cite State Radiation Control Act].
    (2) "Agency" means [cite appropriate State agency].
    (3) "Agreement state" means any State with which the United States Atomic Energy Commission has entered into an effective agreement under Section 274 b. of the Atomic Energy Act of 1954, as amended (73 Stat. 689).
    (4) "Airborne radioactive material" means any radioactive material dispersed in the air in the form of dusts, fumes, mists, vapors, or gases.
    (5) "Byproduct material" means any radioactive material (except special nuclear material) yielded in or made radioactive by exposure to the radiation incident to the process of producing or utilizing special nuclear material.
    (6) "Calendar quarter" means any period determined according to either of the following subdivisions:
        (i) The first period of any year may begin on any date in January; provided that the second, third and fourth periods accordingly begin on the same date in April, July and October, respectively and that the fourth period extend into January of the succeeding year, if necessary to complete a three-month quarter. During the first year of use of this method of determination by a licensee or registrant, the first period for that year shall also include any additional days in January preceding the starting date for the first period.
        (ii) The first period in a calendar year of 13 complete, consecutive calendar weeks; the second period in a calendar year of 13 complete, consecutive calendar

---

1/ Attention is directed to the fact that regulation by the State of source material, byproduct material, and special nuclear material in quantities not sufficient to form a critical mass is subject to the provisions of the agreement between the State and the U.S. Atomic Energy Commission and to Part 150 of the Commission's regulations (10 C.F.R. Part 150).

weeks; the third period in a calendar year of 13 complete, consecutive calendar weeks; the fourth period in a calendar year of 13 complete, consecutive calendar weeks. Alternatively, the four periods may consist of the first 14 complete, consecutive calendar weeks; the next 12 complete, consecutive calendar weeks; the next 14 complete, consecutive calendar weeks, and the last 12 complete, consecutive calendar weeks. If at the end of a calendar year there are any days not falling within a complete calendar week of that year, such days shall be included (for purposes of these regulations) within the last complete calendar week of that year. If at the beginning of any calendar year there are days not falling within a complete calendar week of that year, such days shall be included (for purposes of these regulations) within the last complete calendar week of the previous year. No licensee or registrant shall change the method observed by him of determining calendar quarters for purposes of these regulations except at the beginning of a calendar year.

(7) "Human use" means the internal or external administration of radiation or radioactive materials to human beings.

(8) "Individual" means any human being.

(9) "License," except where otherwise specified, means a license issued pursuant to Part B.

(10) "Occupational dose" means exposure of an individual to radiation (i) in a restricted area; or (ii) in the course of employment in which the individual's duties involve exposure to radiation; provided, that occupational dose shall not be deemed to include any exposure of an individual to radiation for the purpose of medical diagnosis or medical therapy of such individual.

(11) "Person" means any individual, corporation, partnership, firm, association, trust, estate, public or private institution, group, agency, political subdivision of this State, any other State or political subdivision or agency thereof, and any legal successor, representative, agent or agency of the foregoing, other than the United States Atomic Energy Commission, and other than Federal Government Agencies [licensed by the United States Atomic Energy Commission].

(12) "Pharmacist" [means an individual registered by this State to compound and dispense drugs, prescriptions, and poisons].

(13) "Physician" [means an individual licensed by this State to dispense drugs in the practice of medicine].

(14) "Radiation" means gamma rays and X-rays, alpha and beta particles, high-speed electrons, neutrons, and other nuclear particles; but not sound or radio waves, or visible, infrared, or ultra-violet light.

(15) "Radiation machine" means any device capable of producing radiation except devices which produce radiation only from radioactive material.

(16) "Radioactive material" means any material, solid, liquid, or gas, which emits radiation spontaneously.

(17) "Research and development" means: (1) theoretical analysis, exploration, or experimentation; or (2) the extension of investigative findings and theories of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, devices, equipment, materials, and processes. Research and development does not include the internal or external administration of radiation or radioactive material to human beings.

(18) "Restricted area" means any area access to which is controlled by the licensee or registrant for purposes of protection of individuals from exposure to radiation and radioactive materials. "Restricted area" shall not include any areas used for residential quarters, although /upon authorization by the Agency/ a separate room or rooms in a residential building may be set apart as a restricted area.

(19) "Sealed source" means radioactive material that is permanently bonded or fixed in a capsule or matrix designed to prevent release and dispersal of the radioactive material under the most severe conditions which are likely to be encountered in normal use and handling.

(20) "Source material" means: (1) uranium or thorium, or any combination thereof, in any physical or chemical form, or (2) ores which contain by weight one-twentieth of one percent (0.05 percent) or more of (i) uranium, (ii) thorium, or (iii) any combination thereof. Source material does not include special nuclear material.

(21) "Source of radiation" means any radioactive material, or any device or equipment emitting or capable of producing radiation.

(22) "Special nuclear material in quantities not sufficient to form a critical mass" means uranium enriched in the isotope U 235 in quantities not exceeding 350 grams of contained U 235; uranium 233 in quantities not exceeding 200 grams; plutonium in quantities not exceeding 200 grams; or any combination of them in accordance with the following formula: For each kind of special nuclear material, determine the ratio between the quantity specified above for the same kind of special nuclear material. The sum of such ratios for all of the kinds of special nuclear material in combination shall not exceed "1" (i.e., unity). For example, the following quantities in combination would not exceed the limitation and are within the formula, as follows:

$$\frac{175 \text{ (grams contained U 235)}}{350} + \frac{50 \text{ (grams U 233)}}{200} + \frac{50 \text{ (grams Pu)}}{200} = 1$$

(22) "These regulations" means Parts A, B, C, D, E, and F.

(23) "Unrefined and unprocessed ore" means ore in its natural form prior to any processing, such as grinding, roasting, beneficiating, or refining.

(24) "Unrestricted area" means any area access to which is not controlled by the licensee or registrant for purposes of protection of individuals from exposure to radiation and radioactive materials, and any area used for residential quarters.

(b) Definitions of certain other words and phrases as used in these regulations are set forth in other sections, including:
(1) "Dose to the whole body" defined in Section C.101;
(2) "Personnel monitoring equipment" defined in Section C.202;
(3) "Radiation area" and "high radiation area" defined in Section C.202;
(4) "Survey" defined in Section C.201;
(5) Units of measurement of dose (rad, rem) defined in Section A.3;
(6) Units of measurement of radioactivity defined in Section A.4.

Sec. A.3 Units of Radiation Dose.

(a) "Dose" is the quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body. When these regulations specify a dose during a period of time, the dose means the total quantity of radiation absorbed, per unit of mass, by the body or by any portion of the body during such period of time. Several different units of dose are in current use. Definitions of units as used in these regulations are set forth in paragraphs (b) and (c) of this section.

(b) The rad is a measure of the dose of any radiation to body tissues in terms of the energy absorbed per unit mass of the tissue. One rad is the dose corresponding to the absorption of 100 ergs per gram of tissue. (One millirad (mrad) = 0.001 rad.)

(c) The rem is a measure of the dose of any radiation to body tissue in terms of its estimated biological effect relative to a dose of one roentgen (r) of X-rays. (One millirem (mrem) = 0.001 rem.) The relation of the rem to other dose units depends upon the biological effect under consideration and upon the conditions of irradiation. For the purposes of these regulations, any of the following is considered to be equivalent to a dose of one rem:
(1) A dose of 1 r due to X-, or gamma radiation;
(2) A dose of 1 rad due to X-, gamma, or beta radiation;
(3) A dose of 0.1 rad due to neutrons or high energy protons;

(4) A dose of 0.05 rad due to particles heavier than protons and with sufficient energy to reach the lens of the eye. If it is more convenient to measure the neutron flux, or equivalent, than to determine the neutron dose in rads, as provided in subparagraph (3) of this paragraph, one rem of neutron radiation may, for purposes of these regulations, be assumed to be equivalent to 14 million neutrons per square centimeter incident upon the body; or, if there exists sufficient information to estimate with reasonable accuracy the approximate distribution in energy of the neutrons, the incident number of neutrons per square centimeter equivalent to one rem may be estimated from the following table:

Neutron Flux Dose Equivalents

Neutron energy (Mev)	Number of neutrons per square centimeter equivalent to a dose of 1 rem (neutrons/cm^2)	Average flux to deliver 100 millirem in 40 hrs. (neutrons/cm^2 per sec.)
Thermal	970×10^6	670
0.0001	720×10^6	500
0.005	820×10^6	570
0.02	400×10^6	280
0.1	120×10^6	80
0.5	43×10^6	30
1.0	26×10^6	18
2.5	29×10^6	20
5.0	26×10^6	18
7.5	24×10^6	17
10.0	24×10^6	17
10 to 30	14×10^6	10

(d) For determining the doses specified in Sections C.101 and C.104(a), a dose from X- or gamma rays up to 3 Mev may be assumed to be equivalent to the exposure measured by a properly calibrated appropriate instrument in air at or near the body surface in the region of highest dose rate.

Sec. A.4 Units of Radioactivity.

(a) Radioactivity shall be measured in terms of curies. A curie is that quantity of radioactive material which decays at the rate of 3.7×10^{10} disintegrations per second or 2.2×10^{12} disintegrations per minute, except as provided in paragraph (c) of this section. A commonly used submultiple of the curie is the microcurie (uc). One uc = 0.000001 c = 3.7×10^4 dps = 2.2×10^6 dpm.

(b) For purposes of these regulations, it may be assumed that the daughter activity concentrations in the following table are equivalent to an air concentration of 10^{-7} microcuries of Radon 222 per milliliter of air in equilibrium with the daughters RaA, RaB, RaC, and RaC':

Maximum Time Between Collection and Measurement (hours)a/	Alpha-Emitting Daughter Activity Collected Per Milliliter of Air	
	Microcuries/ml	Total alpha disintegrations per minute per ml.
0.5	7.2×10^{-8}	0.16
1.0	4.5×10^{-8}	0.10
2.0	1.3×10^{-8}	0.023
3.0	0.3×10^{-8}	0.0072

a/ The duration of sample collection and the duration of measurement should be sufficiently short compared to the time between collection and measurement, as not to have a statistically significant effect upon the results.

(c) Natural Uranium and Natural Thorium.

(1) For the purpose of these regulations, one curie of natural uranium (U-natural in Appendix A or B of Part C) means the sum of 3.7×10^{10} disintegrations per second from U 238 plus 3.7×10^{10} dps from U 234 plus 9×10^{8} dps from U 235. Also, a curie of natural thorium (Th-natural in Appendix A or B of Part C) means the sum of 3.7×10^{10} dps from Th 232 plus 3.7×10^{10} dps from Th 228.

(2) For the purpose of these regulations, one curie of natural uranium (U-natural in Appendix A or B of Part C) is equivalent to 3,000 kilograms, or 6,615 pounds of natural uranium; and one curie of natural thorium (Th-natural in Appendix A or B of Part C) is equivalent to 9,000 kilograms or 19,850 pounds of natural thorium.

Sec. A.5 Exemptions. The Agency may, upon application therefor or upon its own initiative, grant such exemptions or exceptions from the requirements of these regulations as it determines are authorized by law and will not result in undue hazard to public health and safety or property.

Sec. A.6 Additional Requirements. The Agency may, by rule, regulation, or order, impose upon any licensee or registrant such requirements in addition to those established in these regulations as it deems appropriate or necessary to minimize danger to public health and safety or property.

Sec. A.7 Violations. An injunction or other court order may be obtained prohibiting any violation of any provision of the Act or any regulation or order issued thereunder. Any person who willfully violates any provision of the Act or any regulation or order issued thereunder may be guilty of a crime and, upon conviction, may be punished by fine or imprisonment or both, as provided by law.

Sec. A.8 Impounding. Sources of radiation shall be subject to impounding pursuant to Section ___ of the Act.

Sec. A.9 Communications. All communications and reports concerning these regulations, and applications filed thereunder, should be addressed to the Agency at its office located at ______________________________________.

PART B

LICENSING AND REGISTRATION

Sec. B.1 Purpose. This part provides for the licensing and registration of sources of radiation.

Sec. B.2 Scope. No person shall receive, possess, use, transfer, own, or acquire radioactive material except as authorized in a specific or general license issued pursuant to this part or as otherwise provided in this part. All other sources of radiation, unless exempt from this part under Sections B.3, B.4, B.5, B.7, or B.60 shall be registered with the Agency in accordance with the requirements of Section B.60 of this part.

EXEMPTIONS

Sec. B.3 Source Material.

(a) Any person is exempt from this part to the extent that such person receives, possesses, uses, or transfers source material in any chemical mixture, compound, solution, or alloy in which the source material is by weight less than 1/20 of 1 percent (0.05 percent) of the mixture, compound, solution, or alloy.

(b) Any person is exempt from this part to the extent that such person receives, possesses, uses, or transfers unrefined and unprocessed ore containing source material; provided that, except as authorized in a specific license, such person shall not refine or process such ore.

(c) Any person is exempt from this part to the extent that such person receives, possesses, uses, or transfers:

(1) Any quantities of thorium contained in (i) incandescent gas mantles, (ii) vacuum tubes, (iii) welding rods, (iv) electric lamps for illuminating purposes provided that each lamp does not contain more than 50 milligrams of thorium, (v) germicidal lamps, sunlamps, and lamps for outdoor or industrial lighting provided that each lamp does not contain more than 2 grams of thorium, or (vi) rare earth metals and compounds, mixtures, and products containing not more than 0.25% by weight thorium, uranium, or any combination of these.

(2) Source material contained in the following products: (i) glazed ceramic tableware, provided that the glaze contains not more than 20 percent by weight source material; (ii) glassware, glass enamel frit containing not more than 10 percent by weight source material; but not including commercially manufactured glass brick, pane glass, ceramic tile or other glass, glass enamel or ceramic used in construction.

(3) Photographic film, negatives, and prints containing uranium or thorium.

(4) Any finished product or part fabricated of, or containing, tungsten or magnesium-thorium alloys; provided that the thorium content of the alloy does not exceed 4 percent by weight and that the exemption contained in this subparagraph shall not be deemed to authorize the chemical, physical, or metallurgical treatment or processing of any such product or part.

(5) Uranium contained in counterweights installed in aircraft, rockets, projectiles, or missiles, or stored or handled in connection with installation or removal of such counterweights when: (i) the counterweights are manufactured in accordance with the specifications contained in a specific license or equivalent licensing document issued by the Agency, the U.S. Atomic Energy Commission, or any agreement state authorizing distribution by the licensee pursuant to this subparagraph or equivalent provisions of the regulations of the AEC or any agreement state; (ii) each counterweight has been impressed with the following legend clearly legible through any plating or other covering: "CAUTION - RADIOACTIVE MATERIAL - URANIUM"; and (iii) the plating or other covering has not been removed or penetrated.

(6) Uranium used as shielding constituting part of any shipping container which is conspicuously and legibly impressed with the legend "CAUTION - RADIOACTIVE SHIELDING - URANIUM" and which meets the specifications for containers for radioactive materials prescribed by Section 78.250, Specification 55, Part 78, of the regulations of the Interstate Commerce Commission (49 C.F.R. 78.250).

(7) Thorium contained in finished optical lenses, provided that each lens does not contain more than 30 percent by weight of thorium; and that the exemption contained in this subparagraph shall not be deemed to authorize either: (i) the shaping, grinding, or polishing of such lens or manufacturing processes other than the assembly of such lens into optical systems and devices without any alteration of the lens; or (ii) the receipt, possession, use, or transfer of thorium contained in contact lenses, or in spectacles, or in eyepieces in binoculars or other optical instruments.

(8) Uranium contained in detector heads for use in fire detection units, provided that each detector head contains not more than 0.005 microcurie of uranium.

(d) The exemptions in paragraph (c) do not authorize the manufacture of any of the products described.

Sec. B.4 Radioactive Materials.

(a) Exempt Concentrations.

(1) Except as provided in paragraph B.4(a)(2) below, any person is exempt from this part to the extent that such person receives, possesses, uses, transfers, owns, or acquires products or materials containing radioactive material in concentrations not in excess of those listed in Schedule C.

(2) No person may introduce radioactive material into a product or material knowing or having reason to believe that it will be transferred to persons exempt under paragraph B.4(a)(1) or equivalent regulations of the U.S. Atomic Energy Commission or any agreement state, except in accordance with a license issued pursuant to Section B.26(h) or the general license provided in Section B.90 of this part.

(b) Certain items containing tritium, promethium 147 or radium. Except for persons who apply tritium, promethium 147 or radium to, or persons who incorporate tritium, promethium 147 or radium into, the following products, any person is exempt from these regulations to the extent that he receives, possesses, uses, transfers, owns, or acquires the following products:2/

(1) Timepieces or hands or dials containing radium or not more than (i) 25 millicuries of tritium per timepiece, (ii) 5 millicuries of tritium per hand, or (iii) 15 millicuries of tritium per dial (bezels when used shall be considered as part of the dial).

(2) Lock illuminators containing not more than 15 millicuries of tritium or not more than 2 millicuries of promethium 147 installed in automobile locks. The levels of radiation from each lock illuminator containing promethium 147 will not exceed 1 millirad per hour at 1 centimeter from any surface when measured through 50 milligrams per square centimeter of absorber.

(3) Balances of precision containing not more than 1 millicurie of tritium per balance or not more than 0.5 millicurie of tritium per balance part.

(4) Automobile shift quadrants containing not more than 25 millicuries of tritium.

(5) Marine compasses containing not more than 750 millicuries of tritium gas and other marine navigational instruments containing not more than 250 millicuries of tritium gas.

2/ Authority to transfer possession or control by the manufacturer, processor, or producer of any equipment, device, commodity, or other product containing source, byproduct, or special nuclear material, intended for use by the general public may be obtained only from the U.S. Atomic Energy Commission, Washington, D.C., 20545.

(6) Thermostat dials and pointers containing not more than 25 millicuries of tritium per thermostat.
(7) Glow lamps containing not more than 10 microcuries of tritium per lamp.
(8) Spark gap tubes containing not more than 30 microcuries of promethium 147. The levels of radiation from each spark gap tube containing promethium 147 will not exceed 0.5 millirad per hour at one centimeter from any surface when measured through 7 milligrams per square centimeter of absorber.

(c) Resins containing scandium 46 and designed for sand consolidation in oil wells. Any person is exempt from these regulations to the extent that such person receives, possesses, uses, transfers, owns or acquires synthetic plastic resins containing scandium 46 which are designed for sand consolidation in oil wells. Such resins shall have been manufactured or imported in accordance with a specific license issued by the U.S. Atomic Energy Commission, or shall have been manufactured in accordance with the specifications contained in a specific license or equivalent licensing document issued by the Agency or any Agreement State to the manufacturer of such resins pursuant to licensing requirements equivalent to those in Sections 32.16 and 32.17 of 10 CFR Part 32 of the regulations of the Atomic Energy Commission. This exemption does not authorize the manufacture of any resins containing scandium 46.

Sec. B.5 Carriers. Common and contract carriers operating within this State are exempt from this part to the extent that they transport or store sources of radiation in the regular course of their carriage for another or storage incident thereto.*

Sec. B.6 U.S. Atomic Energy Commission Contractors. Any U.S. Atomic Energy Commission contractor or subcontractor of the following categories operating within this State is exempt from this part to the extent that such contractor or subcontractor under his contract receives, possesses, uses, transfers, owns or acquires sources of radiation:

(a) Prime contractors performing work for the AEC at U.S. Government-owned or controlled sites;

(b) Prime contractors performing research in, or development, manufacture, storage, testing or transportation of, atomic weapons or components thereof;

(c) Prime contractors using or operating nuclear reactors or other nuclear devices in a U.S. Government-owned vehicle or vessel; and

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*It is assumed that carriers of radioactive material will be governed by Federal or State regulations.

(d) Any other prime contractor or subcontractor when the State and the AEC jointly determine (i) that, under the terms of the contract or subcontract, there is adequate assurance that the work thereunder can be accomplished without undue risk to the public health and safety and (ii) that, the exemption of such contractor or subcontractor is otherwise appropriate.

Sec. B.7 Other Exemptions. The following machines and equipment are exempt from this part:

(a) Domestic television receivers, providing the dose rate at 5 cm from any outer surface is less than 0.5 mrem per hour.

(b) Other electrical equipment that produces radiation incidental to its operation for other purposes, providing the dose rate to the whole body at the point of nearest approach to such equipment when any external shielding is removed does not exceed 0.5 rem per year. The production testing or factory servicing of such equipment shall not be exempt.

(c) Radiation-producing machines while in transit or storage incident thereto.

LICENSES

Sec. B.20 Types of Licenses. Licenses for radioactive materials are of two types; general and specific. General licenses provided in this part are effective without the filing of applications with the Agency or the issuance of licensing documents to particular persons. Specific licenses are issued to named persons upon applications filed pursuant to this part.

Sec. B.21 General Licenses - Source Material.

(a) A general license is hereby issued authorizing use and transfer of not more than fifteen (15) pounds of source material at any one time by persons in the following categories:

(1) Pharmacists using the source material solely for the compounding of medicinals;
(2) Physicians using the source material for medicinal purposes;
(3) Persons receiving possession of source material from pharmacists and physicians in the form of medicinals or drugs;
(4) Commercial and industrial firms, and research, educational, and medical institutions for research, development, educational, or commercial purposes;

And provided, that no such person shall, pursuant to this general license, receive more than a total of 150 pounds of source material in any one calendar year.

(b) Persons who receive, possess, use, or transfer source material pursuant to the general license issued in paragraph (a) of this section are exempt from the provisions of Part C of these regulations to the extent that such receipt, possession, use, or transfer is within the terms of such general license; provided, however, that this exemption shall not be deemed to apply to any such person who is also in possession of source material under a specific license issued pursuant to this part.

(c) A general license is hereby issued authorizing the receipt of title to source material without regard to quantity. The general license under this paragraph does not authorize any person to receive, possess, use or transfer source material.

Sec. B.22 General Licenses* - Radioactive Material Other Than Source Material.

(a) Scheduled items and generally licensed quantities. A general license is hereby issued:
  (1) To transfer, receive, acquire, own, possess, and use radioactive material incorporated in a device or equipment which is listed in Schedule A and has been manufactured pursuant to a specific license or equivalent licensing document, issued by the Agency, the Atomic Energy Commission, or any agreement state, and authorizing distribution under the general license of this subparagraph or its equivalent; and
  (2) To transfer, receive, acquire, own, possess, and use quantities of radioactive material listed in Schedule B, provided that no person shall at any one time possess or use, pursuant to the general licensing provisions of this subparagraph, more than a total of ten such scheduled quantities.

(b) The general licenses provided in paragraph (a) are subject to the provisions of Section B.31 through B.100 as applicable, and the regulations contained in Part C.3/ In addition, persons who transfer, receive, acquire, own, possess, or use scheduled items or quantities of radioactive material pursuant to the general licenses provided in paragraph (a) of this section:
  (1) Shall not effect an increase in the radioactivity of said scheduled items or quantities by adding other radioactive material thereto, by combining radioactive material from two or more such items or quantities, or by altering them in any other manner so as to increase thereby the rate of radiation therefrom;

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* Different general licenses are issued in this section, each of which has its own specific conditions and requirements.

3/ Attention is directed particularly to the provisions of Part C of these regulations which relate to the labeling of containers.

(2) Shall not administer externally or internally, or direct the administration of, said scheduled items or quantities or any part thereof to a human being for any purpose, including, but not limited to, diagnostic, therapeutic, and research purposes;

(3) Shall not add, or direct the addition of, said scheduled items or quantities or any part thereof to any food, beverage, cosmetic, drug, or other product designed for ingestion or inhalation by, or application to, a human being; and

(4) Shall not include said scheduled items or quantities or any part thereof in any device, instrument, or apparatus (including component parts and accessories thereto) intended for use in diagnosis, treatment, or prevention of disease in human beings or animals or otherwise intended to affect the structure or any function of the body of human beings or animals.

(c) Certain Measuring, Gauging or Controlling Devices.

(1) A general license is hereby issued to own, receive, acquire, possess, and use radioactive material when contained in devices designed and manufactured for the purpose of detecting, measuring, gauging, or controlling thickness, density, level, interface location, radiation leakage, or qualitative or quantitative chemical composition, or for producing light or an ionized atmosphere, when such devices are manufactured in accordance with the specifications contained in a specific license or equivalent licensing document issued to the supplier pursuant to Section B.26(e) or its equivalent by the Agency, the U.S. Atomic Energy Commission, or any agreement state, and authorizing distribution under the general license of this subparagraph or its equivalent; provided, that:

(i) Such devices are labeled in accordance with the provisions of the specific license or equivalent licensing document which authorizes the distribution of the devices;

(ii) Such devices bear a label containing the following or a substantially similar statement which contains the information called for in the following statement:

The receipt, possession, use, and transfer of this device, Model *____________, Serial No. *______________, are subject to a general license or the equivalent and the regulations of the U.S. AEC or of a State with which the AEC has entered into an agreement for the exercise of regulatory authority. Removal of this label is prohibited.

CAUTION - RADIOACTIVE MATERIAL

____

(Name of Supplier)*

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* The model, serial number, and name of supplier may be omitted from this label provided they are elsewhere specified in labeling affixed to the device.

(iii) Such devices are installed on the premises of the general licensee by a person authorized to install such devices under a specific license or equivalent licensing document issued to the installer by the Agency, the U.S. Atomic Energy Commission or any agreement State, if a label affixed to the device at the time of receipt states that installation by a specific licensee is required. The requirement of this paragraph does not apply while devices are held in storage in the original shipping container pending installation by a specific licensee.

(2) Persons who own, receive, acquire, possess, or use a device pursuant to the general license contained in subparagraph (1) of this paragraph:

(i) Shall not transfer, abandon, or dispose of the device except by transfer to a person duly authorized to receive such device by a specific license or equivalent licensing document issued by the Agency, the U.S. Atomic Energy Commission, or any agreement State, and shall furnish to the Agency, within 30 days after any transfer a report containing the name of the manufacturer of the device, the type of device, the manufacturer's serial number of the device, and the name and address of the person receiving the device;

(ii) Shall assure that all labels affixed to the device at the time of receipt and bearing the statement, "Removal of this label is prohibited" are maintained thereon and shall comply with all instructions contained in such labels;

(iii) Shall have the device tested for leakage of radioactive material and proper operation of the on-off mechanism and indicator, if any, at the time of installation of the device or replacement of the radioactive material on the premises of the general licensee and thereafter at no longer than six-month intervals or at such longer intervals not to exceed three years as are specified in the label required by subparagraph (c)(1)(i) of this section: provided, that devices containing only krypton need not be tested for leakage, and devices containing only tritium need not be tested for any purpose;

(iv) Shall have the tests required by subdivision (iii) of this subparagraph and all other services involving the radioactive material, its shielding and containment, performed by the supplier or other person duly authorized by a specific license or equivalent licensing document issued by the Agency, the U.S. Atomic Energy Commission, or any agreement state, to manufacture, install, or service such devices;

(v) Shall, within 30 days after the occurrence of a failure of or damage to the shielding of the radioactive material or the on-off mechanism or indicator or upon the detection of 0.005 microcurie or more of removable radioactive material, furnish to the Agency a report containing the name of the manufacturer of the device, the type of device, the manufacturer's serial number of the device and a brief description of the event and the remedial action taken; and shall maintain records of all tests performed on the devices as required under this section, including the dates and results of the tests and the names of the persons conducting the tests;

(vi) Shall, upon the occurrence of a failure of or damage to, or any indication of a possible failure of or damage to, the shielding or containment of the radioactive material or the on-off mechanism or indicator, immediately suspend operation of the device until it has been repaired by a person holding a specific license or equivalent licensing document issued by the Agency, the U.S. Atomic Energy Commission, or any agreement state, to manufacture, install, or service such devices, or disposed of by transfer to a person holding a specific license or equivalent licensing document issued by the Agency, the U.S. Atomic Energy Commission, or any agreement state to receive the radioactive material contained in the device;

(vii) Shall be exempt from the requirements of Part C of these regulations except that such persons shall comply with the provisions of Sections C.402 and C.403; and

(viii) Shall within ten (10) days after the receipt of the device notify the Agency of the type of device and the name and address of the supplier.

/_(ix) Shall within 30 days after the effective date of these regulations register such devices in his possession._7

/_(x) Shall re-register such devices with the Agency every ____________ ____________ as long as the device is owned, possessed, or used._7

(3) The general licenses provided in this paragraph are subject to the provisions of Sections B.31 to B.100 as applicable.

(d) Luminous Safety Devices for Aircraft.

(1) A general license is hereby issued to own, receive, acquire, possess, and use tritium or promethium 147 contained in luminous safety devices for use in aircraft, provided:

(i) Each device contains not more than four curies of tritium or 100 millicuries of promethium 147; and

(ii) Each device has been manufactured, assembled or imported in accordance with a specific license issued by the U.S. Atomic Energy Commission, or each device has been manufactured or assembled in accordance with the specifications contained in a specific license or equivalent licensing document issued by the Agency or any agreement State to the manufacturer or assembler of such device pursuant to licensing requirements equivalent to those in Section 32.53 of 10 CFR Part 32 of the regulations of the U.S. Atomic Energy Commission.

(2) Persons who own, receive, acquire, possess, or use luminous safety devices pursuant to the general license in subparagraph (1) of this paragraph are exempt from the requirements of Part C, except that they shall comply with the provisions of Sections C.402 and C.403.

(3) This general license does not authorize the manufacture, assembly or repair of luminous safety devices containing tritium or promethium 147.

(4) This general license does not authorize the ownership, receipt, acquisition, possession or use of promethium 147 contained in instrument dials.

(e) Calibration and Reference Sources.

(1) A general license is hereby issued to those persons listed below to own, receive, acquire, possess, use, and transfer, in accordance with the provisions of subparagraphs (3) and (4) of this paragraph (e), americium 241 in the form of calibration or reference sources:

(i) Any person who holds a specific license issued by the Agency which authorizes him to receive, possess, use, and transfer radioactive material; and

(ii) Any person who holds a specific license issued by the U.S. Atomic Energy Commission which authorizes him to receive, possess, use, and transfer special nuclear material.

(2) A general license is hereby issued to receive, possess, use, and transfer plutonium in the form of calibration or reference sources in accordance with the provisions of subparagraphs (3) and (4) of this paragraph (e) to any person who holds a specific license issued by the Agency which authorizes him to receive, possess, use, and transfer radioactive material.

(3) The general licenses in subparagraphs (1) and (2) of this paragraph apply only to calibration or reference sources which have been manufactured in accordance with the specifications contained in a specific license issued to the manufacturer or importer of the sources by the U.S. Atomic Energy Commission pursuant to Section 32.57 of 10 C.F.R. Part 32 or Section 70.39 of 10 C.F.R. Part 70 or which have been manufactured in accordance with the specifications contained in a specific license

or equivalent licensing document issued to the manufacturer by the Agency or any agreement state pursuant to licensing requirements equivalent to those contained in Section 32.57(n) of 10 C.F.R. Part 32 or Section 70.39 of 10 C.F.R. Part 70 of the regulations of the U.S. Atomic Energy Commission.

(4) The general licenses in subparagraphs (1) and (2) of this paragraph are subject to the provisions of Sections A.7, A.8, B.31, B.50, B.70, B.71, B.72 and Part C of these regulations. In addition, persons who own, receive, acquire, possess, use, and transfer one or more calibration or reference sources pursuant to these general licenses:

(i) Shall not possess at any one time, at any one location of storage or use, more than 5 microcuries of americium 241 and 5 microcuries of plutonium in such sources;

(ii) Shall not receive, possess, use, or transfer such source unless the source, or the storage container, bears a label which includes the following statement or a substantially similar statement which contains the information called for in the following statement:

The receipt, possession, use and transfer of this source, Model _____, Serial No. _______, are subject to a general license and the regulations of the U.S. Atomic Energy Commission or of a State with which the Commission has entered into an agreement for the exercise of regulatory authority. Do not remove this label.

CAUTION - RADIOACTIVE MATERIAL - THIS SOURCE CONTAINS (AMERICIUM 241). (PLUTONIUM)*. DO NOT TOUCH RADIOACTIVE PORTION OF THIS SOURCE.

(Name of Manufacturer or Importer);

(iii) Shall not transfer, abandon, or dispose of such source except by transfer to a person authorized by a license from the Agency, the U.S. Atomic Energy Commission, or an agreement state to receive the source;

(iv) Shall store such source, except when the source is being used, in a closed container adequately designed and constructed to contain americium 241 or plutonium which might otherwise escape during storage; and

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*Showing only the name of the appropriate material.

(v) Shall not use such source for any purpose other than the calibration of radiation detectors or the standardization of other sources.

(5) These general licenses do not authorize the manufacture of calibration or reference sources containing americium 241 or plutonium.

(f) Ownership of Byproduct Material. A general license is hereby issued to own byproduct material without regard to quantity. Notwithstanding any other provisions of this part, this general license does not authorize the manufacture, production, transfer, receipt, possession or use of byproduct material.

(g) Medical Diagnostic Uses.

(1) A general license is hereby issued to any physician to receive, possess, transfer, or use for any of the following stated diagnostic uses, in accordance with the provisions of subparagraphs (2), (3) and (4) of this paragraph, the following byproduct materials in capsules, disposable syringes or other forms of prepackaged individual doses;*

(i) Iodine 131 as sodium iodide (NaI^{131}) for measurement of thyroid uptake;

(ii) Iodine 131 as iodinated human serum albumin (IHSA) for determinations of blood and blood plasma volume;

(iii) Iodine 125 as iodinated human serum albumin (IHSA) for determinations of blood and blood plasma volume;

(iv) Cobalt 58 for the measurement of intestinal absorption of cyanocobalamin;

(v) Cobalt 60 for the measurement of intestinal absorption of cyanocobalamin;

(vi) Chromium 51 as sodium radiochromate for determination of red blood cell volumes and studies of red blood cell survival time.

(2) No physician shall receive, possess, use, or transfer byproduct material pursuant to the general license established by subparagraph (1) of this paragraph until he has filed Form ______, "Certificate - Medical Use of Byproduct Material Under General License" with the Agency and received from the Agency a validated copy of the Form _____ with certification number assigned. The general licensed physician shall furnish on Form _________ the following information and such other information as may be required by that form:

(i) Name and address of the generally licensed physician;

(ii) A statement that the generally licensed physician is a duly licensed physician authorized to dispense drugs in the practice of medicine in this State; and

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*Subsection B.26(i) requires manufacturers of radiopharmaceuticals which are under the general license in this paragraph to affix a certain identifying label to the container or in the leaflet or brochure which accompanies the radiopharmaceutical.

(iii) A statement that the generally licensed physician has appropriate radiation measuring instruments to carry out the diagnostic procedures for which he proposes to use byproduct material under the general license of B.22(g) and that he is competent in the use of such instruments.

(3) A physician who receives, possesses, or uses a pharmaceutical containing byproduct material pursuant to the general license established by subparagraph (1) of this paragraph shall comply with the following:

(i) He shall not possess at any one time, pursuant to the general license in subparagraph (1) of this paragraph, more than:

(a) 200 microcuries of iodine 131;
(b) 200 microcuries of iodine 125;
(c) 5 microcuries of cobalt 58;
(d) 5 microcuries of cobalt 60; and
(e) 200 microcuries of chromium 51.

(ii) He shall store the pharmaceutical unit administered in the original shipping container, or a container providing equivalent radiation protection;

(iii) He shall use the pharmaceutical only for the uses authorized by subparagraph (1) of this paragraph;

(iv) He shall not administer the pharmaceutical to a woman with confirmed pregnancy or to a person under 18 years of age; and,

(v) He shall not transfer the byproduct material to a person who is not authorized to receive it pursuant to a license issued by the Agency, the U.S. Atomic Energy Commission or any agreement State, or in any manner other than in the unopened, labeled shipping container as received from the supplier, except by administering it to a patient.

(4) The generally licensed physician possessing or using byproduct material under the general license of subparagraph (1) shall report in duplicate to the Agency, any changes in the information furnished by him in the "Certificate - Medical Use of Byproduct Material Under General License," Form__________. The report shall be submitted within 30 days after the effective date of such change.

(5) Any person using byproduct material pursuant to the general license of subparagraph (1) of this paragraph is exempt from the requirements of Part C of these regulations with respect to the byproduct materials covered by the general license.

(h) Ice Detection Devices.

(1) A general license is hereby issued to own, receive, acquire, possess, use, and transfer strontium 90 contained in ice detection devices, provided each device contains not more than fifty microcuries of strontium 90 and each device has been manufactured or imported in accordance with a specific license issued

by the U.S. Atomic Energy Commission or each device has been manufactured in accordance with the specifications contained in a specific license or equivalent licensing document issued by the Agency or any agreement State to the manufacturer of such device pursuant to licensing requirements equivalent to those in Section 32.61 of 10 CFR Part 32 of the regulations of the Atomic Energy Commission.

(2) Persons who own, receive, acquire, possess, use, or transfer strontium 90 contained in ice detection devices pursuant to the general license in subparagraph (1) of this paragraph (h):
   - (i) Shall, upon occurrence of visually observable damage, such as a bend or crack or discoloration from overheating, to the device, discontinue use of the device until it has been inspected, tested for leakage and repaired by a person holding a specific license or equivalent licensing document from the U.S. Atomic Energy Commission or an agreement State to manufacture or service such devices; or shall dispose of the device pursuant to the provisions of this regulation;
   - (ii) Shall assure that all labels affixed to the device at the time of receipt, and which bear a statement which prohibits removal of the labels, are maintained thereon;
   - (iii) Are exempt from the requirements of Part C except that such persons shall comply with the provisions of Sections C.301, C.402, and C.403 of these regulations; and
   - (iv) Are exempt from the requirements of this part except that such persons shall comply with the provisions of Sections B.31, B.50, B.70, B.71 and B.72.

(3) This general license does not authorize the manufacture, assembly, disassembly or repair of strontium 90 in ice detection devices.

Sec. B.23 /For future additions/

SPECIFIC LICENSES

Sec. B.24 Filing of Application for Specific Licenses.

(a) Applications for specific licenses shall be filed in /tripilicate/ /quadruplicate/ on a form prescribed by the Agency.

(b) The Agency may at any time after the filing of the original application, and before the expiration of the license, require further statements in order to enable the Agency to determine whether the application should be granted or denied or whether a license should be modified or revoked.

(c) Each application shall be signed by the applicant or licensee or a person duly authorized to act for and on his behalf.

(d) An application for a license may include a request for a license authorizing one or more activities.

(e) In his application, the applicant may incorporate by reference information contained in previous applications, statements, or reports filed with the Agency provided such references are clear and specific.

(f) Applications and documents submitted to the Agency may be made available for public inspection except that the Agency may withhold any document or part thereof from public inspection if disclosure of its contents is not required in the public interest and would adversely affect the interest of a person concerned.

Sec. B.25 General Requirements for the Issuance of Specific Licenses. A license application will be approved if the Agency determines that:

(a) The applicant is qualified by reason of training and experience to use the material in question for the purpose requested in accordance with these regulations in such a manner as to minimize danger to public health and safety or property; and,

(b) The applicant's proposed equipment, facilities, and procedures are adequate to minimize danger to public health and safety or property; and,

(c) The issuance of the license will not be inimical to the health and safety of the public; and,

(d) The applicant satisfies any applicable special requirements in this Part B.

Sec. B.26 Special Requirements for Issuance of Specific Licenses for Radioactive Materials.

(a) Human Use of Radioactive Materials in Institutions. In addition to the requirements set forth in Section B.25 above, a specific license for human use of radioactive material in institutions will be issued only if:
  (1) The applicant has appointed a medical isotopes committee of at least three members to evaluate all proposals for research, diagnostic, and therapeutic use of radioisotopes within that institution. Membership of the committee should include physicians expert in internal medicine, hematology, therapeutic radiology, and a person experienced in assay of radioisotopes and protection against radiation; and,

(2) The applicant possesses adequate facilities for the clinical care of patients; and,

(3) The physician designated on the application as the individual user has substantial experience in the handling and administration of radioisotopes and, where applicable, the clinical management of radioactive patients; and,

(4) If the application is for a license to use unspecified quantities or multiple types of radioactive material, the applicant's staff has substantial experience in the use of a variety of radioactive materials for a variety of human uses.

(b) Licensing of Individual Physicians for Human Use of Radioactive Materials. In addition to the requirements set forth in Section B.25 above, a specific license for the human use of radioactive materials will be issued to an individual physician only if:

(1) The applicant has access to a hospital possessing adequate facilities to hospitalize and monitor the applicant's radioactive patients whenever it is advisable; and,

(2) The applicant has extensive experience in the handling and administration of radioisotopes and, where applicable, the clinical management of radioactive patients.

(c) Human Use of Sealed Sources. In addition to the requirements set forth in Section B.25 above, a specific license for human use of sealed sources will be issued only if the applicant, or if the application is made by an institution, the individual user (i) has specialized training in the therapeutic use of the sealed source considered (teletherapy unit, beta applicator, etc.) or has experience equivalent to such training, and (ii) is a physician.

(d) Multiple Quantities or Types of Radioactive Material for Use in Research and Development. In addition to the requirements set forth in Section B.25 above, a specific license for multiple quantities or types of radioactive material for use in research and development will be issued only if:

(1) The applicant's staff has substantial experience in the use of a variety of radioisotopes for a variety of research and development uses; and,

(2) The applicant has established an isotope committee (composed of such persons as a radiological safety officer, a representative of the business office, and one or more persons trained or experienced in the safe use of radioactive materials) which will review and approve, in advance of purchase of radioisotopes, proposals for such use; and,

(3) The applicant has appointed a radiological safety officer who will advise and assist on radiological safety problems.

(e) Distribution of Devices to Persons Generally Licensed Under Section B.22(c). In addition to the requirements set forth in Section B.25 above, a specific license to distribute certain devices of the types enumerated in Section B.22(c) to persons generally licensed under Section B.22(c) will be issued only if:

- (1) The applicant submits sufficient information relating to the design, manufacture, prototype testing, quality control procedures, labeling, proposed uses, and potential hazards of the device to provide reasonable assurance that:
    - (i) The radioactive material contained in the device will not be lost;
    - (ii) No individual will receive a radiation exposure to a major portion of his body in excess of 0.5 rem in a year under ordinary circumstances of use;
    - (iii) The device can be safely operated by individuals not having training in radiological protection; and,
    - (iv) The radioactive material within the device will not be accessible to unauthorized individuals.
- (2) In describing the label or labels and contents thereon to be affixed to the device, the applicant should separately indicate those instructions and precautions which are necessary to assure safe operation of the device. Such instructions and precautions must be contained on labels bearing the statement, "Removal of this label is prohibited."
- (3) In the event the applicant desires that the device be tested for proper operation of the on-off mechanism and indicator, if any, and for leakage of radioactive material, subsequent to the initial tests required by Section B.22(c)(2)(iii), at intervals longer than six months but not exceeding three years, he shall include in his application sufficient information to demonstrate that such longer interval is justified by performance characteristics of the device or similar devices, and by design features which have a significant bearing on the probability or consequences of leakage of radioactive material from the device. In determining the acceptable interval for test of leakage of radioactive material, the Agency will consider information on particulars which include, but are not necessarily limited to:
    - (i) Primary containment (source capsule);
    - (ii) Protection of primary containment;
    - (iii) Method of sealing containment;
    - (iv) Containment construction materials;
    - (v) Form of contained radioactive material;
    - (vi) Maximum temperature withstood during prototype tests;
    - (vii) Maximum pressure withstood during prototype tests;
    - (viii) Maximum quantity of contained radioactive material;

(ix) Radiotoxicity of contained radioactive material; and,
(x) Operating experience with identical devices or similarly designed and constructed devices.

(f) Use of Sealed Sources in Industrial Radiography.[4] In addition to the requirements set forth in Section B.25 above, a specific license for use of sealed sources in industrial radiography will be issued only if:

(1) The applicant will have an adequate program for training radiographers and radiographers' assistants and submits to the Agency a schedule or description of such program which specifies the:
   (i) Initial training;
   (ii) Periodic training;
   (iii) On-the-job training;
   (iv) Means to be used by the licensee to determine the radiographer's knowledge and understanding of and ability to comply with Agency regulations and licensing requirements, and the operating and emergency procedures of the applicant;
(2) The applicant has established and submits to the Agency satisfactory written operating and emergency procedures as described in Section D.202; and,
(3) The applicant will have an adequate internal inspection system, or other management control, to assure that license provisions, regulations, and the applicant's operating and emergency procedures are followed by radiographers and radiographers' assistants; and,
(4) The applicant submits to the Agency a description of his overall organizational structure pertaining to the industrial radiography program, including specified delegations of authority and responsibility for operation of the program; and,
(5) The applicant who desires to conduct his own leak tests has established adequate procedures to be followed in leak testing sealed sources for possible leakage and contamination and submits to the Agency a description of such procedures including:
   (i) Instrumentation to be used;
   (ii) Method of performing tests, e.g., points on equipment to be smeared and method of taking smear; and,
   (iii) Pertinent experience of the person who will perform the test.

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[4] Industrial radiography for the purpose of this paragraph means the examination of the structure of materials by nondestructive methods utilizing sealed sources of radioactive material.

(g) Multiple Quantities or Types of Radioactive Material for Use in Processing. In addition to the requirements set forth in Section B.25 above, a specific license for multiple quantities or types of radioactive material for use in processing for distribution to other authorized persons will be issued only if:5/

(1) The applicant's staff has substantial experience in the use of a variety of radioisotopes for processing and distribution; and

(2) The applicant has appointed a radiological safety officer who will advise and assist on radiological safety problems.

(h) Licensing the Introduction of Radioactive Material into Products in Exempt Concentrations. In addition to the requirements set forth in Section B.25 above, a specific license authorizing the introduction of radioactive material into a product or material owned by or in the possession of the licensee or another to be transferred to persons exempt under paragraph B.4(a)(1) will be issued only if:

(1) The applicant submits a description of the product or material into which the radioactive material will be introduced, intended use of the radioactive material and the product or material into which it is introduced, method of introduction, initial concentration of the radioactive material in the product or material, control methods to assure that no more than the specified concentration is introduced into the product or material, estimated time interval between introduction and transfer of the product or material, and estimated concentration of the radioactive material in the product or material at the time of transfer; and

(2) The applicant provides reasonable assurance that the concentrations of radioactive material at the time of transfer will not exceed the concentrations in Schedule C, that reconcentration of the radioactive material in concentrations exceeding those in Schedule C is not likely, that use of lower concentrations is not feasible, and that the product or material is not likely to be incorporated in any food, beverage, cosmetic, drug or other commodity or product designed for ingestion or inhalation by, or application to, a human being.

Each person licensed under this paragraph (h) shall file an annual report with the Agency describing the type and quantity of each product or material into which radioactive material has been introduced during the reporting period, name and address of the person who owns or possesses the product or material into which radioactive material has been introduced, the type

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5/ Authority to transfer possession or control by the manufacturer, processor, or producer of any equipment, device, commodity, or other product containing source, byproduct, or special nuclear material, intended for use by the general public may be obtained only from the U.S. Atomic Energy Commission, Washington, D.C., 20545.

and quantity of radioactive material introduced into each such product or material, and the initial concentrations of radioactive material in the product or material at time of transfer of the radioactive material by the licensee. The report shall be submitted within 30 days after the end of each calendar year* in which the licensee introduces radioactive material into a product or material pursuant to a license granted under this paragraph.

(i) Manufacture and Distribution of Byproduct Materials for Medical Use Under General License. In addition to requirements set forth in Section B.25 above, a specific license authorizing the distribution of byproduct material for use by physicians under the general license in paragraph B.22(g) will be issued only if:

(1) The applicant submits evidence that the byproduct material is to be manufactured, labeled, and packaged in accordance with a new drug application which the Commissioner of Food and Drugs, Food and Drug Administration, has approved, or in accordance with a license for a biologic product issued by the Secretary, Department of Health, Education, and Welfare; and,

(2) The following statement, or a substantially similar statement which contains the information called for in the following statement, appears on the label affixed to the container or appears in the leaflet or brochure which accompanies the package:

"This radioactive drug may be received, possessed, and used only by physicians licensed to dispense drugs in the practice of medicine. Its receipt, possession, use and transfer are subject to the regulations and a general license or the equivalent of the U.S. Atomic Energy Commission or of a State with which the Commission has entered into an agreement for the exercise of regulatory authority.

____
(Name of Manufacturer)"

Sec. B.30 Issuance of Specific Licenses.

(a) Upon a determination that an application meets the requirements of the Act and the regulations of the Agency, the Agency will issue a specific license authorizing the proposed activity in such form and containing such conditions and limitations as it deems appropriate or necessary.

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*The equivalent AEC regulation requires this report on a calendar year basis. However, a report for the year ending June 30, as formerly provided in the Suggested Regulations, is equally acceptable.

(b) The Agency may incorporate in any license at the time of issuance, or thereafter by appropriate rule, regulation, or order, such additional requirements and conditions with respect to the licensee's receipt, possession, use, and transfer of radioactive material subject to this part as it deems appropriate or necessary in order to:
  (1) Minimize danger to public health and safety or property;
  (2) Require such reports and the keeping of such records, and to provide for such inspections of activities under the license as may be appropriate or necessary; and
  (3) Prevent loss or theft of material subject to this part.

Sec. B.31 Specific Terms and Conditions of Licenses.

(a) Each license issued pursuant to this part shall be subject to all the provisions of the Act, now or hereafter in effect, and to all rules, regulations, and orders of the Agency.

(b) Neither the license nor any right under the license shall be assigned or otherwise transferred in violation of the provisions of the Act.

(c) Each person licensed by the Agency pursuant to this part shall confine his use and possession of the material licensed to the locations and purposes authorized in the license.

(d) Each licensee authorized under Section B.26(e) to distribute certain devices to generally licensed persons:
  (1) Shall report to the Agency all transfers of such devices to persons generally licensed under Section B.22(c). Such report shall identify each general licensee by name and address, the type of device transferred, and the quantity and type of radioactive material contained in the device. The report shall be submitted within 30 days after the end of each calendar quarter in which such a device is transferred to generally licensed persons; and
  (2) Shall furnish to each general licensee in this State to whom he transfers such device a copy of the general license contained in Section B.22(c).*

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*As an alternative, the Agency may wish to distribute copies of the general license contained in B.22(c) to general licensees within the State rather than require that the supplier of the device do so.

Sec. B.32 Expiration of Licenses. Except as provided in Section B.33(b), each specific license shall expire at the end of the day, in the month and year stated therein.*

Sec. B.33 Renewal of License.

(a) Applications for renewal of specific licenses shall be filed in accordance with Section B.24.

(b) In any case in which a licensee, not less than thirty (30) days prior to expiration of his existing license, has filed an application in proper form for renewal or for a new license authorizing the same activities, such existing license shall not expire until the application has been finally determined by the Agency.

Sec. B.34 Amendment of Licenses at Request of Licensee. Applications for amendment of a license shall be filed in accordance with Section B.24 and shall specify the respects in which the licensee desires his license to be amended and the grounds for such amendment.

Sec. B.35 Agency Action on Applications to Renew or Amend. In considering an application by a licensee to renew or amend his license, the Agency will apply the criteria set forth in Sections B.25 and B.26, as applicable.

Sec. B.36 Inalienability of Licenses. No license issued or granted under this part and no right to possess or utilize radioactive material granted by any license issued pursuant to this part shall be transferred, assigned, or in any manner disposed of, either voluntarily or involuntarily, directly or indirectly, through transfer of control of any license to any person unless the Agency shall, after securing full information find that the transfer is in accordance with the provisions of the Act, and shall give its consent in wirting.

Sec. B.37 Persons Possessing a License for Source, Byproduct, or Special Nuclear Material in Quantities Not Sufficient to Form a Critical Mass on Effective Date of These Regulations. Any person who, on the effective date of these regulations, possesses a general or specific license for source, byproduct, or special nuclear material in quantities not sufficient to form a critical mass, issued by the United States Atomic Energy Commission, shall be deemed to possess a like license issued under this part and the Act, such license to expire either ninety (90) days after receipt from the Agency of a notice of expiration of such license, or on the date of expiration specified in the United States Atomic Energy Commission license, whichever is earlier.

Sec. B.38 Persons Possessing Radioactive Material Other Than Agreement Material on Effective Date of These Regulations. Any person who, on the effective date of these regulations, possesses naturally occurring or accelerator-produced radioactive material for which a specific license is required by the Act or this part shall be deemed to possess such a license issued under the Act and this part. Such license shall expire ninety (90) days after the effective date of these regulations; provided, however, that if within the ninety (90) days the person possessing such material files an application in proper form for a license, such existing license shall not expire until the application has been finally determined by the Agency.

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*Other appropriate time for expiration may be specified, including different times of expiration for each material.

Sec. B.40 Transfer of Material.

(a) No licensee shall transfer radioactive material except as authorized pursuant to this section.

(b) Any licensee may transfer radioactive material:
  (1) To the Agency;
  (2) To the U.S. Atomic Energy Commission;
  (3) To any person exempt from the regulations in this part to the extent permitted under such exemption;
  (4) To any person authorized to receive such material under terms of a general license or its equivalent, or a specific license or equivalent licensing document, issued by the Agency, the U.S. Atomic Energy Commission, or any agreement state, or to any person otherwise authorized to receive such material by the Federal Government or any agency thereof, the Agency, or any agreement state; or
  (5) As otherwise authorized by the Agency in writing.

Sec. B.50 Modification, Revocation, and Termination of Licenses.

(a) The terms and conditions of all licenses shall be subject to amendmend, revision, or modification or the license may be suspended or revoked by reason of amendments to the Act, or by reason of rules, regulations, and orders issued by the Agency.

(b) Any license may be revoked, suspended, or modified, in whole or in part, for any material false statement in the application or any statement of fact required under provisions of the Act, or because of conditions revealed by such application or statement of fact or any report, record, or inspection or other means which would warrant the Agency to refuse to grant a license on an original application, or for violation of, or failure to observe any of, the terms and conditions of the Act, or the license, or of any rule, regulation, or order of the Agency.

(c) Except in cases of willfulness or those in which the public health, interest, or safety requires otherwise, no license shall be modified, suspended, or revoked unless, prior to the institution of proceedings therefor, facts or conduct which may warrant such action shall have been called to the attention of the licensee in writing and the licensee shall have been accorded an opportunity to demonstrate or achieve compliance with all lawful requirements.

(d) The Agency may terminate a specific license upon request submitted by the licensee to the Agency in writing.

REGISTRATION

Sec. B.60 Registration.

(a) The owner or person having possession of any radiation machine, except those specifically exempted in Sections B.5, B.6 and B.7, shall:

(1) Register such machine* with the Agency (within thirty (30) days following the effective date of these regulations or)*** within ten (10) days after acquisition of such machine. Registration shall be on forms available from the Agency.***

(2) Designate an individual who will be responsible for radiation protection for the machine. Such individual shall:

(i) Be qualified by training and experience concerning all hazards and precautions involved in operating the machine for which he is responsible;

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* Instead of registering radiation machines as provided in this section, the State may prefer to register installations. An "installation" is defined as the location where one or more radiation machines are installed in such a fashion as to be capable of producing radiation or where a mobile or portable radiation machine is normally stored or used.

** Optional - For use by States which are initiating a registration program on the effective date of the regulations.

***The States may wish to require at least the following information on the registration form:

1. Name, address and telephone number of the owner or person having possession of the machine;
2. Name, address (if different than that shown in 1.) and discipline of the individual in charge of radiation protection;
3. The address and specific confines where the machine is maintained and used, or, if such machine is mobile, the address and specific confines where usually stored;
4. The type and number of machines at a specific location; and
5. The date of application and signature of the registrant.

(ii) Recommend a detailed program of radiation safety for effective compliance with the applicable requirements of these regulations;

(iii) Give instructions concerning hazards and safety practices to individuals who may be exposed to radiation from the machine; and

(iv) Make surveys and carry out other procedures as required by these regulations.

When, in the opinion of the Agency, the individual designated to be responsible for radiation safety does not have qualifications sufficient to insure safety of the machine for which he is responsible, the Agency may order the registrant to designate another individual who meets the requirements of this subparagraph.

(b) A Notice of Registration will be provided by the Agency and shall be retained by the registrant for the registration period indicated thereon.

(c) The registrant shall notify the Agency within ten (10) days after any change which renders the information on the initial registration no longer accurate.

/_(d) The owner or person having possession of any registered radiation machine shall re-register such machine with the Agency every ______ ________ as long as the activity requiring such registration continues._7

(e) No person, in any advertisement, shall refer to the fact that a radiation machine is registered with the Agency and no person shall state or imply that any activity under such registration has been approved by the Agency.

(f) The registrant shall be subject to all applicable requirements of these regulations.

RECORDS, INSPECTIONS, AND TESTS

Sec. B.70 Records. Each licensee and registrant shall keep records showing the receipt, transfer, and disposal of all sources of radiation.

Sec. B.71 Inspections.

(a) Each licensee and registrant shall afford the Agency at all reasonable times opportunity to inspect sources of radiation and the premises and facilities wherein such sources of radiation are used or stored.

(b) Each licensee and registrant shall make available to the Agency for inspection, upon reasonable notice, records maintained pursuant to these regulations.

Sec. B.72 Tests. Each licensee and registrant shall perform, upon instructions from the Agency, or shall permit the Agency to perform, such reasonable tests as the Agency deems appropriate or necessary including, but not limited to, tests of:

(a) Sources of radiation;

(b) Facilities wherein sources of radiation are used or stored;

(c) Radiation detection and monitoring instruments; and

(d) Other equipment and devices used in connection with utilization or storage of licensed or registered sources of radiation.

RECIPROCITY

Sec. B.90 Reciprocal Recognition of Licenses.

(a) Subject to these regulations, any person who possesses a specific license or equivalent licensing document issued by the U.S. Atomic Energy Commission or any agreement state, other than this State, may conduct the activities authorized in such licensing document within this State for a period not in excess of twenty days in any period of twelve (12) consecutive months without obtaining a specific license from the Agency, provided that:
(1) The licensing document does not limit the activity authorized by such document to specified installations or locations; and
(2) The out-of-state licensee notifies the Agency in writing at least two (2) days prior to engaging in such activity. Such notification shall indicate the location, period, and type of proposed possession and use within this State, and shall be accompanied by a copy of the pertinent licensing document. If, for a specific case, the two (2) day period would impose an undue hardship on the out-of-state licensee, he may, upon application to the Agency, obtain permission to proceed sooner; and
(3) The out-of-state licensee complies with all applicable regulations of the Agency and with all the terms and conditions of his licensing document, except any such terms and conditions which may be inconsistent with applicable regulations of the Agency; and
(4) The out-of-state licensee supplies such other information as the Agency may request.

(b) To the extent provided in Sections B.3, B.4, and B.22, any person may transfer, receive, acquire, own, possess, and use any equipment, device, commodity, or other product containing radioactive material which has been manufactured, processed, or produced in accordance with a specific license or equivalent licensing document issued by the U.S. Atomic Energy Commission or any agreement State.

(c) Notwithstanding the provisions of paragraph (a) of this Section B.90, any person who holds a specific license or equivalent licensing document issued by the U.S. Atomic Energy Commission or an agreement state authorizing the holder to manufacture, install, or service a device described in Section B.22(c)(1) within areas subject to the jurisdiction of the licensing body is hereby granted a general license to install and service such device in this State provided that:

(1) Such person shall file a report with the Agency within thirty (30) days after the end of each calendar quarter in which any device is transferred to or installed in this State. Each such report shall identify each general licensee by name and address, the type of device transferred, and the quantity and type of radioactive material contained in the device;

(2) The device has been manufactured, labeled, installed, and serviced in accordance with applicable provisions of the specific license or equivalent licensing document issued to such person by the U.S. Atomic Energy Commission or an agreement state;

(3) Such person shall assure that any labels required to be affixed to the device under regulations of the authority which licensed manufacture of the device bear a statement that "Removal of this label is prohibited"; and

(4) The holder of the specific license or equivalent licensing document shall furnish to each general licensee to whom he transfers such device or on whose premises he installs such device a copy of the general license contained in Section B.22(c)*.

(d) The Agency may withdraw, limit, or qualify its acceptance of any specific license or equivalent licensing document issued by another agency, or any product distributed pursuant to such licensing document, upon determining that such action is necessary in order to prevent undue hazard to public health and safety or property.**

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* Supra footnote (*), page 27.

**If the Agency does not possess the authority to grant recognition to a license issued by the U.S. Atomic Energy Commission or an agreement state as indicated above, a paragraph should be added indicating that temporary licenses will be issued when a person has complied with the provisions of Section B.90.

TRANSPORTATION

Sec. B.100 Intrastate Transportation of Radioactive Materials.

(a) The provisions of this section apply to transportation of radioactive material, or the delivery of radioactive material to a carrier for transportation, which is not subject to the rules and regulations of the Atomic Energy Commission, the Interstate Commerce Commission, the Federal Aviation Agency, the Coast Guard, or the Post Office.

(b) No licensee shall transport any radioactive material outside of the confines of his plant or other authorized location of use, or deliver any radioactive material to a carrier for transportation, unless the licensee complies with all requirements, appropriate to the mode of transportation, relating to the packaging of the radioactive material and to the marking and labeling of the package and transporting vehicle, of the rules and regulations, as amended, of the Interstate Commerce Commission (49 C.F.R. Parts 73, 77, and 78), Federal Aviation Agency (14 C.F.R. Part 49), and Coast Guard (46 C.F.R. Part 146), to the same extent as if the transportation were subject to the rules and regulations of any such Agency.

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SCHEDULE A

The following devices and equipment incorporating radioactive material, when manufactured, tested, and labeled by the manufacturer in accordance with the specifications contained in a specific license or equivalent licensing document issued by the Agency, the U.S. Atomic Energy Commission, or any agreement state are placed under a general license pursuant to Section B.22(a)(1).

(a) Static Elimination Device. Devices designed for use as static eliminators which contain, as a sealed source or sources, radioactive material consisting of a total of not more than five hundred (500) microcuries of polonium 210 per device.

(b) Spark Gap and Electronic Tubes. Spark gap tubes and electronic tubes which contain radioactive material consisting of not more than five (5) microcuries per tube of cesium 137, or nickel 63, or krypton 85 gas, or not more than one (1) microcurie per tube of cobalt 60.

(c) Light Meter. Devices designed for use in measuring or determining light intensity which contain, as a sealed source or sources, radioactive material consisting of a total of not more than two hundred (200) microcuries of strontium 90 per device.

(d) Ion Generating Tube. Devices designed for ionization of air which contain, as a sealed source or sources, radioactive material consisting of a total of not more than five hundred (500) microcuries of polonium 210 per device or a total of not more than fifty (50) millicuries of hydrogen 3 (tritium) per device.

PART B
SCHEDULE B

GENERALLY LICENSED QUANTITIES

Radioactive Material	Column 1 Not as a sealed source (microcuries)	Column 2 As a sealed source (microcuries)
Antimony 124 (Sb 124)...................	1	10
Arsenic 76 (As 76)......................	10	10
Arsenic 77 (As 77)......................	10	10
Barium 150-Lanthanum 140 (BaLa 140).....	1	10
Beryllium 7 (Be 7)......................	50	50
Cadmium 109-Silver 109 (CdAg 109).......	10	10
Calcium 45 (Ca 45)......................	10	10
Carbon 14 (C14).........................	50	50
Cerium 144-Praseodymium 144 (CePr 144)..	1	10
Cesium 137-Barium 137 (CsBa 137)........	1	10
Chlorine 36 (Cl 36).....................	1	10
Chromium 51 (Cr 51).....................	50	50
Cobalt 60 (Co 60).......................	1	10
Copper 64 (Cu 64).......................	50	50
Europium 154 (Eu 154)...................	1	10
Fluorine 18 (F 18)......................	50	50
Gallium 72 (Ga 72)......................	10	10
Germanium 71 (Ge 71)....................	50	50
Gold 198 (Au 198).......................	10	10
Gold 199 (Au 199).......................	10	10
Hydrogen 3 (Tritium) (H 3)..............	250	250
Indium 114 (In 114).....................	1	10
Iodine 131 (I 131)......................	10	10
Iridium 192 (Ir 192)....................	10	10
Iron 55 (Fe 55).........................	50	50
Iron 59 (Fe 59).........................	1	10
Lanthanum 140 (La 140)..................	10	10
Manganese 52 (Mn 52)....................	1	10
Manganese 56 (Mn 56)....................	50	50
Molybdenum 99 (Mo 99)...................	10	10
Nickel 59 (Ni 59).......................	1	10
Nickel 63 (Ni 63).......................	1	10
Niobium 95 (Nb 95)......................	10	10
Palladium 109 (Pd 109)..................	10	10
Palladium 103-Rhodium 103 (PdRh 103)....	50	50
Phosphorus 32 (P 32)....................	10	10
Polonium 210 (Po 210)...................	0.1	1
Potassium 42 (K 42).....................	10	10
Praseodymium 143 (Pr 143)...............	10	10
Promethium 147 (Pm 147).................	10	10
Radium 226 (Ra 226).....................	0.1	1
Rhenium 186 (Re 186)....................	10	10
Rhodium 105 (Rh 105)....................	10	10
Rubidium 86 (Rb 86).....................	10	10
Ruthenium 106-Rhodium 106 (RuRh 106)....	1	10

SCHEDULE B

GENERALLY LICENSED QUANTITIES--Continued

Radioactive Material	Column 1 Not As a sealed source (microcuries)	Column 2 As a sealed source (microcuries)
Samarium 153 (Sm 153)................	10	10
Scandium 46 (Sc 46)..................	1	10
Silver 105 (Ag 105)..................	1	10
Silver 111 (Ag 111)..................	10	10
Sodium 22 (Na 22)....................	10	10
Sodium 24 (Na 24)....................	10	10
Strontium 89 (Sr 89).................	1	10
Strontium 90-Yttrium 90 (Sr Y 90)....	0.1	1
Sulfur 35 (S 35).....................	50	50
Tantalum 182 (Ta 182)................	10	10
Technetium 96 (Tc 96)................	1	10
Technetium 99 (Tc 99)................	1	10
Tellurium 127 (Te 127)...............	10	10
Tellurium 129 (Te 129)...............	1	10
Thallium 204 (Tl 204)................	50	50
Tin 113 (Sn 113).....................	10	10
Tungsten 181 (W 181).................	10	100
Tungsten 185 (W 185).................	10	10
Vanadium 48 (V 48)...................	1	10
Yttrium 90 (Y 90)....................	1	10
Yttrium 91 (Y 91)....................	1	10
Zinc 65 (Zn 65)......................	10	10
Alpha-emitting radioactive material, other than special nuclear material, not listed above....................	0.1	1
Beta and/or gamma-emitting radioactive material not listed above.....	1	10

PART B
SCHEDULE C

EXEMPT CONCENTRATIONS

Element (atomic number)	Isotope	Column I Gas concentration uc/ml[1]	Column II Liquid and solid concentration uc/ml[2]
Antimony (51)	Sb 122		3X10^{-4}
	Sb 124		2X10^{-4}
	Sb 125		1X10^{-3}
Argon (18)	A 37	1X10^{-3}	
	A 41	4X10^{-7}	
Arsenic (33)	As 73		5X10^{-3}
	As 74		5X10^{-4}
	As 76		2X10^{-4}
	As 77		8X10^{-4}
Barium (56)	Ba 131		2X10^{-3}
	Ba 140		3X10^{-4}
Beryllium (4)	Be 7		2X10^{-2}
Bismuth (83)	Bi 206		4X10^{-4}
Bromine (35)	Br 82	4X10^{-7}	3X10^{-3}
Cadmium (48)	Cd 109		2X10^{-3}
	Cd 115 m		3X10^{-4}
	Cd 115		3X10^{-4}
Calcium (20)	Ca 45		9X10^{-5}
	Ca 47		5X10^{-4}
Carbon (6)	C 14	1X10^{-6}	8X10^{-3}
Cerium (58)	Ce 141		9X10^{-4}
	Ce 143		4X10^{-4}
	Ce 144		1X10^{-4}
Cesium (55)	Cs 131		2X10^{-2}
	Cs 134 m		6X10^{-2}
	Cs 134		9X10^{-5}
Chlorine (17)	Cl 38	9X10^{-7}	4X10^{-3}
Chromium (24)	Cr 51		2X10^{-2}
Cobalt (27)	Co 57		5X10^{-3}
	Co 58		1X10^{-3}
	Co 60		5X10^{-4}
Copper (29)	Cu 64		3X10^{-3}
Dysprosium (66)	Dy 165		4X10^{-3}
	Dy 166		4X10^{-4}
Erbium (68)	Er 169		9X10^{-4}
	Er 171		1X10^{-3}
Europium (63)	Eu 152 (T/2=9.2 Hrs)		6X10^{-4}
	Eu 155		2X10^{-3}
Fluorine (9)	F 18	2X10^{-6}	8X10^{-3}
Gadolinium (64)	Gd 153		2X10^{-3}
	Gd 159		8X10^{-4}

SCHEDULE C

EXEMPT CONCENTRATIONS--Continued

Element (atomic number)	Isotope	Column I Gas concentration uc/ml[1]	Column II Liquid and solid concentration uc/ml[2]
Gallium (31)	Ga 72		$4X10^{-4}$
Germanium (32)	Ge 71		$2X10^{-2}$
Gold (79)	Au 196		$2X10^{-3}$
	Au 198		$5X10^{-4}$
	Au 199		$2X10^{-3}$
Hafnium (72)	Hf 181		$7X10^{-4}$
Hydrogen (1)	H 3	$5X10^{-6}$	$3X10^{-2}$
Indium (49)	In 113 m		$1X10^{-2}$
	In 114 m		$2X10^{-4}$
Iodine (53)	I 126	$3X10^{-9}$	$2X10^{-5}$
	I 131	$3X10^{-9}$	$2X10^{-5}$
	I 132	$8X10^{-8}$	$6X10^{-4}$
	I 133	$1X10^{-8}$	$7X10^{-5}$
	I 134	$2X10^{-7}$	$1X10^{-3}$
Iridium (77)	Ir 190		$2X10^{-3}$
	Ir 192		$4X10^{-4}$
	Ir 194		$3X10^{-4}$
Iron (26)	Fe 55		$8X10^{-3}$
	Fe 59		$6X10^{-4}$
Krypton (36)	Kr 85 m	$1X10^{-6}$	
	Kr 85	$3X10^{-6}$	
Lanthanum (57)	La 140		$2X10^{-4}$
Lead (82)	Pb 203		$4X10^{-3}$
Lutetium (71)	Lu 177		$1X10^{-3}$
Manganese (25)	Mn 52		$3X10^{-4}$
	Mn 54		$1X10^{-3}$
	Mn 56		$1X10^{-3}$
Mercury (80)	Hg 197 m		$2X10^{-3}$
	Hg 197		$3X10^{-3}$
	Hg 203		$2X10^{-4}$
Molybdenum (42)	Mo 99		$2X10^{-3}$
Neodymium (60)	Nd 149		$3X10^{-3}$
	Nd 147		$6X10^{-4}$
Nickel (28)	Ni 65		$1X10^{-3}$
Niobium (Columbium) (41)	Nb 95		$1X10^{-3}$
	Nb 97		$9X10^{-3}$
Osmium (76)	Os 185		$7X10^{-4}$
	Os 191 m		$3X10^{-2}$
	Os 191		$2X10^{-3}$
	Os 193		$6X10^{-4}$
Palladium (46)	Pd 103		$3X10^{-3}$
	Pd 109		$9X10^{-4}$
Phosphorus (15)	P 32		$2X10^{-4}$

SCHEDULE C
EXEMPT CONCENTRATIONS--Continued

Element (atomic number)	Isotope	Column I Gas concentration uc/ml[1]	Column II Liquid and solid concentration uc/ml[2]
Platinum (78)	Pt 191		$1X10^{-3}$
	Pt 193 m		$1X10^{-2}$
	Pt 197 m		$1X10^{-2}$
	Pt 197		$1X10^{-3}$
Polonium (84)	Po 210	$2X10^{-10}$	$7X10^{-6}$
Potassium (19)	K 42		$3X10^{-3}$
Praseodymium (59)	Pr 142		$3X10^{-4}$
	Pr 143		$5X10^{-4}$
Promethium (61)	Pm 147		$2X10^{-3}$
	Pm 149		$4X10^{-4}$
Radium (88)	Ra 226	$1X10^{-11}$	$1X10^{-7}$
	Ra 228	$2X10^{-11}$	$3X10^{-7}$
Rhenium (75)	Re 183		$6X10^{-3}$
	Re 186		$9X10^{-4}$
	Re 188		$6X10^{-4}$
Rhodium (45)	Rh 103 m		$1X10^{-1}$
	Rh 105		$1X10^{-3}$
Rubidium (37)	Rb 86		$7X10^{-4}$
Ruthenium (44)	Ru 97		$4X10^{-3}$
	Ru 103		$8X10^{-4}$
	Ru 105		$1X10^{-3}$
	Ru 106		$1X10^{-4}$
Samarium (62)	Sm 153		$8X10^{-4}$
Scandium (21)	Sc 46		$4X10^{-4}$
	Sc 47		$9X10^{-4}$
	Sc 48		$3X10^{-4}$
Selenium (34)	Se 75		$3X10^{-3}$
Silicon (14)	Si 31		$9X10^{-3}$
Silver (47)	Ag 105		$1X10^{-3}$
	Ag 110 m		$3X10^{-4}$
	Ag 111		$4X10^{-4}$
Sodium (11)	Na 24		$2X10^{-3}$
Strontium (38)	Sr 89		$1X10^{-4}$
	Sr 91		$7X10^{-4}$
	Sr 92		$7X10^{-4}$
Sulfur (16)	S 35	$9X10^{-8}$	$6X10^{-4}$
Tantalum (73)	Ta 182		$4X10^{-4}$
Technetium (43)	Tc 96 m		$1X10^{-1}$
	Tc 96		$1X10^{-3}$
Tellurium (52)	Te 125 m		$2X10^{-3}$
	Te 127 m		$6X10^{-4}$
	Te 127		$3X10^{-3}$
	Te 129 m		$3X10^{-4}$
	Te 131 m		$6X10^{-4}$
	Te 132		$3X10^{-4}$

SCHEDULE C

EXEMPT CONCENTRATIONS--Continued

Element (atomic number)	Isotope	Column I Gas concentration uc/ml[1]	Column II Liquid and solid concentration uc/ml[2]
Terbium (65)	Tb 160		4X10^{-4}
Thallium (81)	Tl 200		4X10^{-3}
	Tl 201		3X10^{-3}
	Tl 202		1X10^{-3}
	Tl 204		1X10^{-3}
Thulium (69)	Tm 170		5X10^{-4}
	Tm 171		5X10^{-3}
Tin (50)	Sn 113		9X10^{-4}
	Sn 125		2X10^{-4}
Tungsten (Wolfram) (74)	W 181		4X10^{-3}
	W 187		7X10^{-4}
Vanadium (23)	V 48		3X10^{-4}
Xenon (54)	Xe 131 m	4X10^{-6}	
	Xe 133	3X10^{-6}	
	Xe 135	1X10^{-6}	
Ytterbium (70)	Yb 175		1X10^{-3}
Yttrium (39)	Y 90		2X10^{-4}
	Y 91 m		3X10^{-2}
	Y 91		3X10^{-4}
	Y 92		6X10^{-4}
	Y 93		3X10^{-4}
Zinc (30)	Zn 65		1X10^{-3}
	Zn 69 m		7X10^{-4}
	Zn 69		2X10^{-2}
Zirconium (40)	Zr 95		6X10^{-4}
	Zr 97		2X10^{-4}
Beta and/or gamma emitting radioactive material not listed above with half-life less than 3 years		1X10^{-10}	1X10^{-6}

NOTE 1: Many radioisotopes disintegrate into isotopes which are also radioactive. In expressing the concentrations in Appendix C, the activity stated is that of the parent isotope and takes into account the daughters.

SCHEDULE C

EXEMPT CONCENTRATIONS--Continued

NOTE 2: For purposes of Section 3.420 where there is involved a combination of isotopes, the limit for the combination should be derived as follows: Determine for each isotope in the product the ratio between the concentration present in the product and the exempt concentration established in Appendix C for the specific isotope when not in combination. The sum of such ratios may not exceed "1" (i.e., unity).

EXAMPLE:

$$\frac{\text{Concentration of Isotope A in Product}}{\text{Exempt concentration of Isotope A}} + \frac{\text{Concentration of Isotope B in Product}}{\text{Exempt concentration of Isotope B}} \leq 1$$

[1] Values are given only for those materials normally used as gases.

[2] uc/gm for solids.

PART C

STANDARDS FOR PROTECTION AGAINST RADIATION

Sec. C.1 Purpose and Scope. This part establishes standards for protection against radiation hazards. Except as otherwise specifically provided, this part applies to all licensees or registrants.

PERMISSIBLE DOSES, LEVELS, AND CONCENTRATIONS

Sec. C.101 Exposure of Individuals to Radiation in Restricted Areas.

(a) Except as provided in paragraph (b) of this section, no licensee or registrant shall possess, use, receive, or transfer sources of radiation in such a manner as to cause any individual in a restricted area to receive in any period of one calendar quarter from all sources of radiation in the licensee's or registrant's possession a dose in excess of the limits specified in the following table:

	Rems per Calendar Quarter
Whole body; head and trunk; active blood-forming organs; lens of eyes; or gonads.	1 1/4
Hands and forearms; feet and ankles.	18 3/4
Skin of whole body.	7 1/2

(b) A licensee or registrant may permit an individual in a restricted area to receive a dose to the whole body greater than that permitted under paragraph (a) of this section, provided:

(1) During any calendar quarter the dose to the whole body from sources of radiation in the licensee's or registrant's possession shall not exceed 3 rems; and,

(2) The dose to the whole body, when added to the accumulated occupational dose to the whole body, shall not exceed 5 (N-18) rems where "N" equals the individual's age in years at his last birthday; and,

(3) The licensee or registrant has determined the individual's accumulated occupational dose to the whole body on Agency Form "Y," or on a clear and legible record containing all the information required in that form, and has otherwise complied with the requirements of Section C.102.

As used in paragraph (b), "dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of eye.

Sec. C.102 Determination of Accumulated Dose.

(a) This section contains requirements which must be satisfied by licensees or registrants who propose, pursuant to paragraph (b) of Section C.101, to permit individuals in a restricted area to receive exposure to radiation in excess of the limits specified in paragraph (a) of Section C.101.

(b) Before permitting any individual in a restricted area to receive exposure to radiation in excess of the limits specified in paragraph (a) of Section C.101, each licensee or registrant shall:

(1) Obtain a certificate on Agency Form "Y," or on a clear and legible record containing all the information required in that form, signed by the individual, showing each period of time after the individual attained the age of 18 in which the individual received an occupational dose of radiation; and,

(2) Calculate on Agency Form "Y," in accordance with the instructions appearing therein, or on a clear and legible record containing all the information required in that form, the previously accumulated occupational dose received by the individual and the additional dose allowed for that individual under Section C.101(b).

(c) (1) In the preparation of Agency Form "Y," or a clear and legible record containing all the information required in that form, the licensee or registrant shall make a reasonable effort to obtain reports of the individual's previously accumulated occupational dose. For each period for which the licensee or registrant obtains such reports, he shall use the dose shown in the report in preparing the form. In any case where a licensee or registrant is unable to obtain reports of the individual's occupational dose for a previous complete calendar quarter, it shall be assumed that the individual has received the occupational dose specified in whichever of the following colums apply:

Part of Body	Column 1 Assumed Dose in Rems for Calendar Quarters Prior to January 1, 1961	Column 2 Assumed Dose in Rems For Calendar Quarters Beginning on or After January 1, 1961
Whole body, gonads, active blood-forming organs, head and trunk, lens of eye	3 3/4	1 1/4

(2) The licensee or registrant shall retain and preserve records used in preparing Agency Form "Y." If calculation of the individual's accumulated occupational dose for all periods prior to January 1, 1961, yields a result higher than the applicable accumulated dose value for the individual as of that date, as specified in paragraph (b) of Section C.101, the excess may be disregarded.

Sec. C.103 Exposure of Individuals to Concentrations of Radioactive Material in Restricted Areas.

(a) No licensee shall possess, use, receive, or transfer radioactive material in such a manner as to cause an individual in a restricted area to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Appendix A, Table I, of this part. "Expose," as used in this section, means that the individual is present in an airborne concentration. No allowance shall be made for the use of protective clothing or equipment, or particle size, except as authorized by the Agency pursuant to paragraph (c) of this section.

(b) The limits given in Appendix A, Table I, of this part are based upon exposure to the concentrations specified for forty hours in any period of seven consecutive days. In any such period where the number of hours of exposure is less than forty, the limits specified in the table may be increased proportionately. In any such period where the number of hours of exposure is greater than forty, the limits specified in the table shall be decreased proportionately.

(c) (1) Except as authorized by the Agency pursuant to this paragraph, no allowance shall be made for particle size or the use of protective clothing or equipment in determining whether an individual is exposed to an airborne concentration in excess of the limits specified in Appendix A, Table I.

(2) The Agency may authorize a licensee to expose an individual in a restricted area to airborne concentrations in excess of the limits specified in Appendix A, Table I, upon receipt of an application demonstrating that the concentration is composed in whole or in part of particles of such size that such particles are not respirable and that the individual will not inhale the concentrations in excess of the limits established in Appendix A, Table I. Each application under this subparagraph shall include an analysis of particle sizes in the concentrations and a description of the methods used in determining the particle sizes.

(3) The Agency may authorize a licensee to expose an individual in a restricted area to airborne concentrations in excess of the limits specified in Appendix A, Table I, upon receipt of an application demonstrating that the individual will wear appropriate protective equipment and that the individual will not inhale, ingest, or absorb quantities of radioactive material in excess of those which might otherwise be permitted under this part for individuals in restricted areas during a 40-hour week. Each application under this subparagraph shall contain the following information:

(i) A description of the protective equipment to be employed, including the efficiency of the equipment for the material involved;

(ii) Procedures for the fitting, maintenance, and cleaning of the protective equipment;

(iii) Procedures governing the use of the protective equipment, including supervisory procedures and length of time the equipment will be used by the individuals in each work week. The proposed periods for use of the equipment by any individual should not be of such duration as would discourage observance by the individual of the proposed procedures; and,

(iv) The average concentrations present in the areas occupied by individuals.

Sec. C.104 Exposure of Minors.

(a) No licensee or registrant shall possess, use, or transfer sources of radiation in such a manner as to cause any individual within a restricted area, who is under 18 years of age, to receive in any period of one calendar quarter from all sources of radiation in such licensee's or registrant's possession a dose in excess of 10 percent of the limits specified in the table in paragraph (a) of Section C.101.

(b) No licensee shall possess, use, or transfer radioactive material in such a manner as to cause any individual within a restricted area, who is under 18 years of age, to be exposed to airborne radioactive material in an average concentration in excess of the limits specified in Appendix A, Table II, of this part. For purposes of this paragraph, concentrations may be averaged over periods not greater than a week.

(c) The provisions of paragraph (c), Section C.103, shall apply to exposures subject to paragraph (b) of this section.

Sec. C.105 Permissible Levels of Radiation From External Sources in Unrestricted Areas.

(a) Except as authorized by the Agency pursuant to paragraph (b) of this section, no licensee or registrant shall possess, use, or transfer sources of radiation in such a manner as to create in any unrestricted area from such sources of radiation in his possession:

(1) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of two millirems in any one hour; or,

(2) Radiation levels which, if an individual were continuously present in the area, could result in his receiving a dose in excess of 100 millirems in any seven consecutive days.

(b) Any person may apply to the Agency for proposed limits upon levels of radiation in unrestricted areas in excess of those specified in subparagraph (1) and (2) of paragraph (a) of this section resulting from the applicant's possession or use of sources of radiation. Such applications should include information as to anticipated average radiation levels and anticipated occupancy times for each unrestricted area involved. The Agency will approve the proposed limits if the applicant demonstrates to the satisfaction of the Agency that the proposed limits are not likely to cause any individual to receive a dose to the whole body in any period of one calendar year in excess of 0.5 rem.

Sec. C.106 Concentration in Effluents to Unrestricted Areas.

(a) A licensee shall not possess, use, or transfer licensed material so as to release to an unrestricted area radioactive material in concentrations which exceed the limits specified in Appendix A, Table II of this part, except as authorized pursuant to Section C.302 or paragraph (b) of this section. For purposes of this section concentrations may be averaged over a period not greater than one year.

(b) An application for a license or amendment may include proposed limits higher than those specified in paragraph (a) of this section. The Agency will approve the proposed limits if the applicant demonstrates:

(1) That the applicant has made a reasonable effort to minimize the radioactivity contained in effluents to unrestricted areas; and,

(2) That it is not likely that radioactive material discharged in the effluent would result in the exposure of an individual to concentrations of radioactive material in air or water exceeding the limits specified in Appendix A, Table II of this part.

(c) An application for higher limits pursuant to paragraph (b) of this section shall include information demonstrating that the applicant has made a reasonable effort to minimize the radioactivity discharged in effluents to unrestricted areas, and shall include, as pertinent:

(1) Information as to flow rates, total volume of effluent, peak concentration of each radionuclide in the effluent, and concentration of each radionuclide in the effluent averaged over a period of one year at the point where the effluent leaves a stack, tube, pipe, or similar conduit;

(2) A description of the properties of the effluents, including:

(i) Chemical composition;

(ii) Physical characteristics, including suspended solids content in liquid effluents, and nature of gas or aerosol for air effluents;

(iii) The hydrogen ion concentrations (p^H) of liquid effluents; and,

(iv) The size range of particulates in effluents released into air.

(3) A description of the anticipated human occupancy in the unrestricted area where the highest concentration of radioactive material from the effluent is expected, and, in the case of a river or stream, a description of water uses downstream from the point of release of the effluent.

(4) Information as to the highest concentration of each radionuclide in an unrestricted area, including anticipated concentrations averaged over a period of one year.

(i) In air at any point of human occupancy; or,

(ii) In water at points of use downstream from the point of release of the effluent.

(5) The background concentration of radionuclides in the receiving river or stream prior to the release of liquid effluent.

(6) A description of the environmental monitoring equipment, including sensitivity of the system, and procedures and calculations to determine concentrations of radionuclides in the unrestricted area and possible reconcentrations of radionuclides.

(7) A description of the waste treatment facilities and procedures used to reduce the concentration of radionuclides in effluents prior to their release.

(d) For the purposes of this section, the concentration limits in Appendix A, Table II of this part shall apply at the boundary of the restricted area. The concentration of radioactive material discharged through a stack, pipe or similar conduit may be determined with respect to the point where the material leaves the conduit. If the conduit discharges within the restricted area, the concentration at the boundary may be determined by applying appropriate factors for dilution, dispersion, or decay between the point of discharge and the boundary.

(e) In addition to limiting concentrations in effluent streams, the Agency may limit quantities of radioactive materials released in air or water during a specified period of time if it appears that the daily intake of radioactive material from air, water, or food by a suitable sample of an exposed population group, averaged over a period not exceeding one year, would otherwise exceed the daily intake resulting from continous exposure to air or water containing one-third the concentration of radioactive materials specified in Appendix A, Table II of this part.

(f) The provisions of this section do not apply to disposal of radioactive material into sanitary sewerage systems, which is governed by Section C.303.

Sec. C.107 Orders Requiring Furnishing of Bio-assay Services. Where necessary or desirable in order to aid in determining the extent of an individual's exposure to concentrations of radioactive material, the Agency may incorporate license provisions or issue an order requiring a licensee or registrant to make available to the individual appropriate bio-assay services and to furnish a copy of the reports of such services to the Agency.

PRECAUTIONARY PROCEDURES

Sec. C.201 Surveys.

(a) As used in this part, "survey" means an evaluation of the radiation hazards incident to the production, use, release, disposal, or presence of sources of radiation under a specific set of conditions. When appropriate, such evaluation includes a physical survey of the location of materials and equipment, and measurements of levels of radiation or concentrations of radioactive material present.

(b) Each licensee or registrant shall make or cause to be made such survey as may be necessary for him to comply with this part. 6/

Sec. C.202 Personnel Monitoring.

(a) Each licensee or registrant shall supply appropriate personnel monitoring equipment to, and shall require the use of such equipment by:
  (1) Each individual who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 25 percent of the applicable value specified in paragraph (a) of Section C.101.
  (2) Each individual under 18 years of age who enters a restricted area under such circumstances that he receives, or is likely to receive, a dose in any calendar quarter in excess of 5 percent of the applicable value specified in paragraph (a) of Section C.101.
  (3) Each individual who enters a high radiation area.

6/ The Agency may require licensees or registrants to perform or permit the Agency to perform such reasonable tests as the Agency deems appropriate or necessary in the administration of these regulations (see Section B.72).

(b) (1) "Personnel monitoring equipment" means devices designed to be worn or carried by an individual for the purpose of measuring the dose received (e.g., film badges, pocket chambers, pocket dosimeters, film rings, etc.).

(2) "Radiation area" means any area, accessible to individuals, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 5 millirems, or in any 5 consecutive days a dose in excess of 100 millirems.

(3) "High radiation area" means any area, accessible to individuals, in which there exists radiation at such levels that a major portion of the body could receive in any one hour a dose in excess of 100 millirems.

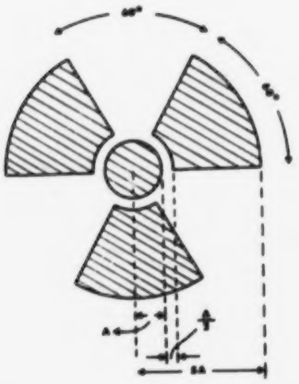
Sec. C.203 Caution Signs, Labels, and Signals.

(a) General.

(1) Except as otherwise authorized by the Agency, symbols prescribed by this section shall use the conventional radiation caution colors (magenta or purple on yellow background). The symbol prescribed by this section is the conventional three-bladed design:

RADIATION SYMBOL

1. Cross-hatched area is to be magenta or purple.
2. Background is to be yellow.



(2) In addition to the contents of signs and labels prescribed in this section, a licensee or registrant may provide on or near such signs and labels any additional information which may be appropriate in aiding individuals to minimize exposure to radiation.

(b) Radiation Areas. Each radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION 7/

RADIATION AREA

(c) High Radiation Areas.

(1) Each high radiation area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION 7/

HIGH RADIATION AREA

(2) Each high radiation area shall be equipped with a control device which shall either cause the level of radiation to be reduced below that at which an individual might receive a dose of 100 millirem in one hour upon entry into the area or shall energize a conspicuous visible or audible alarm signal in such a manner that the individual entering and the licensee, registrant, or supervisor of the activity are made aware of the entry. In the case of a high radiation area established for a period of 30 days or less, such control device is not required.

(d) Airborne Radioactivity Areas.

(1) As used in this part, "airborne radioactivity area" means (i) any room, enclosure, or operating area in which airborne radioactive material exists in concentrations in excess of the amounts specified in Appendix A, Table I, Column 1, of this part; or (ii) any room, enclosure, or operating area in which airborne radioactive material exists in concentrations which, averaged over the number of hours in any week during which individuals are in the area, exceed 25 percent of the amounts specified in Appendix A, Table I, Column 1, of this part.

(2) Each airborne radioactivity area shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and words:

CAUTION 7/

AIRBORNE RADIOACTIVITY AREA

7/ Or "Danger."

(e) Additional Requirements.

(1) Each area or room in which any radioactive material, other than natural uranium or thorium, is used or stored in an amount exceeding 10 times the quantity of radioactive material specified in Appendix B of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION [7]

RADIOACTIVE MATERIAL

(2) Each area or room in which natural uranium or thorium is used or stored in an amount exceeding one hundred times the quantity specified in Appendix B of this part shall be conspicuously posted with a sign or signs bearing the radiation caution symbol and the words:

CAUTION [7]

RADIOACTIVE MATERIAL

(f) Containers.

(1) Except as provided in subparagraph (3) of this paragraph, each container of radioactive material shall bear a durable, clearly visible label identifying the radioactive contents.

(2) A label required pursuant to subparagraph (1) of this paragraph shall bear the radiation caution symbol and the words:

CAUTION [7]

RADIOACTIVE MATERIAL

It shall also provide sufficient information [8] to permit individuals handling or using the containers, or working in the vicinity thereof, to take precautions to avoid or minimize exposures.

(3) Notwithstanding the provisions of subparagraph (1) of this paragraph, labeling is not required:

(i) For containers that do not contain radioactive materials in quantities greater than the applicable quantities listed in Appendix B of this part;

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[7] Or "Danger."

[8] As appropriate, the information will include radiation levels, kinds of material, estimate of activity, date for which activity is estimated, etc.

(ii) For containers containing only natural uranium or thorium in quantities no greater than ten times the applicable quantities listed in Appendix B of this part;

(iii) For containers that do not contain radioactive materials in concentrations greater than the applicable concentrations listed in Column 2, Table I, Appendix A of this part;

(iv) For containers when they are attended by an individual who takes the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established by the regulations in this part;

(v) For containers when they are in transport and packaged and labeled in accordance with regulations published by the Department of Transportation;

(vi) For containers which are accessible[9] only to individuals authorized to handle or use them, or to work in the vicinity thereof, provided that the contents are identified to such individuals by a readily available written record; and

(vii) For manufacturing and process equipment such as piping and tanks.

(g) All radiation machines shall be labeled in a manner which cautions individuals that radiation is produced when the machine is being operated.

Sec. C.204 Exceptions from Posting Requirements. Notwithstanding the provisions of Section C.203.

(a) A room or area is not required to be posted with a caution sign because of the presence of a sealed source, provided the radiation level twelve inches from the surface of the source container or housing does not exceed five millirem per hour.

(b) Rooms or other areas in hospitals are not required to be posted with caution signs because of the presence of patients containing radioactive material, provided that there are personnel in attendance who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive material in excess of the limits established in this part.

(c) Caution signs are not required to be posted at areas or rooms containing radioactive materials for periods of less than eight hours provided that (1) the materials are constantly attended during such periods by an individual who shall take the precautions necessary to prevent the exposure of any individual to radiation or radioactive materials in excess of the limits established in this part, and (2) such area or room is subject to the licensee's or registrant's control.

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[9] For example, containers in locations such as water filled canals, storage vaults, or hot cells.

(d) A room or other area is not required to be posted with a caution sign because of the presence of radioactive materials packaged and labeled in accordance with regulations published by the Department of Transportation.

Sec. C.205 Instruction of Personnel; Posting of Notice to Employees.

(a) Each licensee or registrant shall inform individuals working in or frequenting any portion of a restricted area of the occurrence of radiation or sources of radiation in such portions of the restricted area; shall instruct such individuals in the safety problems associated with exposure to such sources of radiation and in precautions or procedures to minimize exposure; shall instruct such individuals in the applicable provisions of Agency regulations and licenses for the protection of personnel from exposures to radiation or radioactive materials; and shall advise such individuals of reports of radiation exposure which those individuals may request pursuant to this part.

(b) Each licensee or registrant shall post a current copy of this part, a copy of the license [or certificate of registration], and a copy of operating procedures applicable to work under the license [or registration] conspicuously in a sufficient number of places in every establishment where employees are employed in activities licensed or registered pursuant to Part B to permit them to observe a copy on the way to or from their place of employment or shall keep such documents available for examination upon request.

(c) Each licensee or registrant shall conspicuously post Agency Form X, "Notice to Employees," in a sufficient number of places in every establishment where employees are employed in activities licensed or registered, pursuant to Part B, by the Agency to permit employees working in or frequenting any portion of a restricted area to observe a copy on the way to or from their place of employment. Note: Copies of Agency Form X may be obtained by writing to the Agency.

Sec. C.206 Storage of Sources of Radiation. Sources of radiation shall be secured against unauthorized removal from the place of storage.

WASTE DISPOSAL

Sec. C.301 General Requirement. No licensee shall dispose of any radioactive material except:

(a) By transfer to an authorized recipient as provided in Part B, or

(b) As authorized pursuant to Sections C.302, C.303, C.304, or C.106.

Sec. C.302 Method of Obtaining Approval of Proposed Disposal Procedures. Any person may apply to the Agency for approval of proposed procedures to dispose of radioactive material in a manner not otherwise authorized in this part. Each application shall include a description of the radioactive material, including the quantities and kinds of radioactive material and the levels of radioactivity involved, and the proposed manner and conditions of disposal. The application, where appropriate, should also include an analysis and evaluation of pertinent information as to the nature of the environment, including topographical, geological, meteorological, and hydrological characteristics; usage of ground and surface waters in the general area; the nature and location of other potentially affected facilities; and procedures to be observed to minimize the risk of unexpected or hazardous exposures. The Agency will not approve any application for a license to receive radioactive material from other persons for disposal on land not owned by a state or the Federal Government.

Sec. C.303 Disposal by Release Into Sanitary Sewerage Systems. No licensee shall discharge radioactive material into a sanitary sewerage system unless:

(a) It is readily soluble or dispersible in water; and,

(b) The quantity of any radioactive material released into the system by the licensee in any one day does not exceed the larger of subparagraphs (1) or (2) of this paragraph:
   (1) The quantity which, if diluted by the average daily quantity of sewage released into the sewer by the licensee, will result in an average concentration not greater than the limits specified in Appendix A, Table I, Column 2, of this part; or,
   (2) Ten times the quantity of such material specified in Appendix B of this part; and,

(c) The quantity of any radioactive material released in any one month, if diluted by the average monthly quantity of water released by the licensee, will not result in an average concentration exceeding the limits specified in Appendix A, Table I, Column 2, of this part; and,

(d) The gross quantity of radioactive material released into the sewerage system by the licensee does not exceed one curie per year.

Excreta from individuals undergoing medical diagnosis or therapy with radioactive material shall be exempt from any limitations contained in this section.

Sec. C.304 Disposal by Burial in Soil. No licensee shall dispose of radioactive material by burial in soil unless:

(a) The total quantity of radioactive materials buried at any one location and time does not exceed, at the time of burial, 1,000 times the amount specified in Appendix B of this part; and,

(b) Burial is at a minimum depth of four feet; and,

(c) Successive burials are separated by distances of at least six feet and not more than 12 burials are made in any year.

Sec. C.305 Disposal by Incineration. No licensee shall incinerate radioactive material for the purpose of disposal or preparation for disposal except as specifically approved by the Agency pursuant to Sections C.106 and C.302.

RECORDS, REPORTS, AND NOTIFICATION

Sec. C.401 Records of Surveys, Radiation Monitoring, and Disposal.

(a) Each licensee or registrant shall maintain records showing the radiation exposures of all individuals for whom personnel monitoring is required under Section C.202 of this part. Such records shall be kept on Agency Form "Z," in accordance with the instructions contained in that form, or on clear and legible records containing all the information required by Agency Form "Z." The doses entered on the forms or records shall be for periods of time not exceeding one calendar quarter.

(b) Each licensee or registrant shall maintain records in the same units used in this part, showing the results of surveys required by C.201(b), and disposals made under Sections C.302, C.303, and C.304.

(c) Records of individual radiation exposure which must be maintained pursuant to the provisions of paragraph (a) of this section shall be preserved until December 31, 1970, or until a date five (5) years after termination of the individual's employment or association with the licensee or registrant, whichever is later, or such other time as the Agency may determine.[10] (Records which must be maintained pursuant to this part may be maintained in the form of microfilm.)*

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[10] At any time, the Agency may amend this section to assure the further preservation of records which it determines should not be destroyed.

* Where records maintained on microfilm are admissible in evidence under state law, state regulatory agencies may wish to include this provision.

(d) The discontinuance of or curtailment of activities, does not relieve the licensee or registrant of responsibility for retaining all records required by this section. A licensee or registrant may, however, request the Agency to accept such records. The acceptance of the records by the Agency relieves the licensee or registrant of subsequent responsibility only in respect to their preservation as required by this section.

Sec. C.402 Reports of Theft or Loss of Sources of Radiation. Each licensee or registrant shall report by telephone and telegraph to the Agency the theft or loss of any source of radiation immediately after such occurrence becomes known.

Sec. C.403 Notification of Incidents.

(a) Immediate Notification. Each licensee or registrant shall immediately notify the Agency by telephone and telegraph of any incident involving any source of radiation possessed by him and which may have caused or threatens to cause:

(1) Exposure to the whole body of any individual to 25 rems or more of radiation; exposure of the skin of the whole body of any individual of 150 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms of any individual to 375 rems or more of radiation; or,

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 5,000 times the limits specified for such materials in Appendix A, Table II; or,

(3) A loss of one working week or more of the operation of any facilities affected; or,

(4) Damage to property in excess of $100,000.

(b) Twenty-four Hour Notification. Each licensee or registrant shall within 24 hours notify the Agency by telephone and telegraph of any incident involving any source of radiation possessed by him and which may have cuased or threatens to cause:

(1) Exposure of the whole body of any individual to 5 rems or more of radiation; exposure of the skin of the whole body of any individual to 30 rems or more of radiation; or exposure of the feet, ankles, hands, or forearms to 75 rems or more of radiation; or,

(2) The release of radioactive material in concentrations which, if averaged over a period of 24 hours, would exceed 500 times the limits specified for such materials in Appendix A, Table II; or,

(3) A loss of one day or more of the operation of any facilities affected; or,

(4) Damage to property in excess of $1,000.

(c) Any report filed with the Agency pursuant to this section shall be prepared in such a manner that names of individuals who have received exposure to radiation will be stated in a separate part of the report.*

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* This paragraph is suggested for use by states which have the authority to maintain the names of individuals as confidential information.

Sec. C.404 Report to Former Employees and Others of Exposure to Radiation.

(a) A licensee or registrant, at the request of any individual formerly employed or associated with him (i.e., student, craftsmen, etc.), shall furnish to such individual a report of his exposure to radiation as shown in records maintained pursuant to Section C.401(a). Such report shall be furnished within 30 days from the time the request is made; shall cover each calendar quarter of the individual's employment or association involving exposure to radiation, or such lesser period as may be requested by the individual. The report shall also include the results of any calculations and analyses of radioactive material deposited in the body of the individual and made pursuant to the provisions of Section C.107. The report shall be in writing and contain the following statement:

"This report is furnished to you under the provisions of the /cite appropriate Agency/ regulations entitled 'Standards for Protection Against Radiation.' You should preserve this report for future reference."

(b) The individual's request should include appropriate identifying data, such as social security number and dates and locations of employment or association.

Sec. C.405 Reports of Overexposures and Excessive Levels and Concentrations.

(a) In addition to any notification required by Section C.403, each licensee or registrant shall make a report in writing within 30 days to the Agency of (1) each exposure of an individual to radiation or concentrations of radioactive material in excess of any applicable limit as set forth in this part or as otherwise approved by the Agency; (2) any incident for which notification is required by Section C.403; and (3) levels of radiation or concentrations of radioactive material (not involving excessive exposure of any individual) in an unrestricted area in excess of ten times any applicable limit as set forth in this part or as otherwise approved by the Agency. Each report required under this paragraph shall describe the extent of exposure of individuals to radiation or to radioactive material; levels of radiation and concentrations of radioactive material involved; the cause of the exposure, levels, or concentrations; and corrective steps taken or planned to assure against a recurrence.

(b) In any case where a licensee or registrant is required pursuant to the provisions of this section to report to the Agency any exposure of an individual to radiation or to concentrations of radioactive material, the licensee or registrant shall not later than the making of such report to the Agency also notify such individual of the nature and extent of exposure. Such notice shall be in writing and shall contain the following statement:

"This report is furnished to you under the provisions of the /cite appropriate Agency/ regulations entitled 'Standards for Protection Against Radiation.' You should preserve this report for future reference."

(c) Any report filed with the Agency pursuant to this section shall be prepared in such a manner that names of individuals who have received exposure to radiation will be stated in a separate part of the report.*

Sec. C.406 Notice to Employees and Others of Exposure to Radiation. Each licensee or registrant, at the request of any individual employed or associated with him, shall advise such individual annually of the individual's exposure to radiation as shown in records maintained by the licensee or registrant pursuant to Section C.401(a).**

Sec. C.407 Vacating Premises. Each specific licensee shall, no less than 30 days before vacating or relinquishing possession or control of premises which may have been contaminated with radioactive material as a result of his activities, notify the Agency in writing of intent to vacate.

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* This paragraph is suggested for use by states which have the authority to maintain the names of individuals as confidential information.

**If state statutes require the notification of individuals to their exposure to radiation, this section should be deleted.

PART C

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND

[See notes at end of appendix]

Element (atomic number)	Isotope[1]		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml	Column 2 Water (uc/ml)
Actinium (89)---------	Ac 227	S	$2X10^{-12}$	$6X10^{-5}$	$8X10^{-14}$	$2X10^{-6}$
		I	$3X10^{-11}$	$9X10^{-3}$	$9X10^{-13}$	$3X10^{-4}$
	Ac 228	S	$8X10^{-8}$	$3X10^{-3}$	$3X10^{-9}$	$9X10^{-5}$
		I	$2X10^{-8}$	$3X10^{-3}$	$6X10^{-10}$	$9X10^{-5}$
Americium (95)--------	Am 241	S	$6X10^{-12}$	$1X10^{-4}$	$2X10^{-13}$	$4X10^{-6}$
		I	$1X10^{-10}$	$8X10^{-4}$	$4X10^{-12}$	$2X10^{-5}$
	Am 242m	S	$6X10^{-12}$	$1X10^{-4}$	$2X10^{-13}$	$4X10^{-6}$
		I	$3X10^{-10}$	$3X10^{-3}$	$9X10^{-12}$	$9X10^{-5}$
	Am 242	S	$4X10^{-8}$	$4X10^{-3}$	$1X10^{-9}$	$1X10^{-4}$
		I	$5X10^{-8}$	$4X10^{-3}$	$2X10^{-9}$	$1X10^{-4}$
	Am 243	S	$6X10^{-12}$	$1X10^{-4}$	$2X10^{-13}$	$4X10^{-6}$
		I	$1X10^{-10}$	$8X10^{-4}$	$4X10^{-12}$	$3X10^{-5}$
	Am 244	S	$4X10^{-6}$	$1X10^{-1}$	$1X10^{-7}$	$5X10^{-3}$
		I	$2X10^{-5}$	$1X10^{-1}$	$8X10^{-7}$	$5X10^{-3}$
Antimony (51)---------	Sb 122	S	$2X10^{-7}$	$8X10^{-4}$	$6X10^{-9}$	$3X10^{-5}$
		I	$1X10^{-7}$	$8X10^{-4}$	$5X10^{-9}$	$3X10^{-5}$
	Sb 124	S	$2X10^{-7}$	$7X10^{-4}$	$5X10^{-9}$	$2X10^{-5}$
		I	$2X10^{-8}$	$7X10^{-4}$	$7X10^{-10}$	$2X10^{-5}$
	Sb 125	S	$5X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$3X10^{-8}$	$3X10^{-3}$	$9X10^{-10}$	$1X10^{-4}$
Argon (18)------------	A 37	Sub[2]	$6X10^{-3}$	------	$1X10^{-4}$	------
	A 41	Sub	$2X10^{-6}$	------	$4X10^{-8}$	------
Arsenic (33)----------	As 73	S	$2X10^{-6}$	$1X10^{-2}$	$7X10^{-8}$	$5X10^{-4}$
		I	$4X10^{-7}$	$1X10^{-2}$	$1X10^{-8}$	$5X10^{-4}$
	As 74	S	$3X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$5X10^{-5}$
		I	$1X10^{-7}$	$2X10^{-3}$	$4X10^{-9}$	$5X10^{-5}$
	As 76	S	$1X10^{-7}$	$6X10^{-4}$	$4X10^{-9}$	$2X10^{-5}$
		I	$1X10^{-7}$	$6X10^{-4}$	$3X10^{-9}$	$2X10^{-5}$
	As 77	S	$5X10^{-7}$	$2X10^{-3}$	$2X10^{-8}$	$8X10^{-5}$
		I	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$8X10^{-5}$
Astatine (85)---------	At 211	S	$7X10^{-9}$	$5X10^{-5}$	$2X10^{-10}$	$2X10^{-6}$
		I	$3X10^{-8}$	$2X10^{-3}$	$1X10^{-9}$	$7X10^{-5}$
Barium (56)-----------	Ba 131	S	$1X10^{-6}$	$5X10^{-3}$	$4X10^{-8}$	$2X10^{-4}$
		I	$4X10^{-7}$	$5X10^{-3}$	$1X10^{-8}$	$2X10^{-4}$
	Ba 140	S	$1X10^{-7}$	$8X10^{-4}$	$4X10^{-9}$	$3X10^{-5}$
		I	$4X10^{-8}$	$7X10^{-4}$	$1X10^{-9}$	$2X10^{-5}$
Berkelium (97)--------	Bk 249	S	$9X10^{-10}$	$2X10^{-2}$	$3X10^{-11}$	$6X10^{-4}$
		I	$1X10^{-7}$	$2X10^{-2}$	$4X10^{-9}$	$6X10^{-4}$
	Bk 250	S	$1X10^{-7}$	$6X10^{-3}$	$5X10^{-9}$	$2X10^{-4}$
		I	$1X10^{-6}$	$6X10^{-3}$	$4X10^{-8}$	$2X10^{-4}$
Beryllium (4)---------	Be 7	S	$6X10^{-6}$	$5X10^{-2}$	$2X10^{-7}$	$2X10^{-3}$
		I	$1X10^{-6}$	$5X10^{-2}$	$4X10^{-8}$	$2X10^{-3}$

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

[See notes at end of appendix]

Element (atomic number)	Isotope[1]		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
Bismuth (83)----------	Bi 206	S	$2X10^{-7}$	$1X10^{-3}$	$6X10^{-9}$	$4X10^{-5}$
		I	$1X10^{-7}$	$1X10^{-3}$	$5X10^{-9}$	$4X10^{-5}$
	Bi 207	S	$2X10^{-7}$	$2X10^{-3}$	$6X10^{-9}$	$6X10^{-5}$
		I	$1X10^{-8}$	$2X10^{-3}$	$5X10^{-10}$	$6X10^{-5}$
	Bi 210	S	$6X10^{-9}$	$1X10^{-3}$	$2X10^{-10}$	$4X10^{-5}$
		I	$6X10^{-9}$	$1X10^{-3}$	$2X10^{-10}$	$4X10^{-5}$
	Bi 212	S	$1X10^{-7}$	$1X10^{-2}$	$3X10^{-9}$	$4X10^{-4}$
		I	$2X10^{-7}$	$1X10^{-2}$	$7X10^{-9}$	$4X10^{-4}$
Bromine (35)----------	Br 82	S	$1X10^{-6}$	$8X10^{-3}$	$4X10^{-8}$	$3X10^{-4}$
		I	$2X10^{-7}$	$1X10^{-3}$	$6X10^{-9}$	$4X10^{-5}$
Cadmium (48)----------	Cd 109	S	$5X10^{-8}$	$5X10^{-3}$	$2X10^{-9}$	$2X10^{-4}$
		I	$7X10^{-8}$	$5X10^{-3}$	$3X10^{-9}$	$2X10^{-4}$
	Cd 115 m	S	$4X10^{-8}$	$7X10^{-4}$	$1X10^{-9}$	$3X10^{-5}$
		I	$4X10^{-8}$	$7X10^{-4}$	$1X10^{-9}$	$3X10^{-5}$
	Cd 115	S	$2X10^{-7}$	$1X10^{-3}$	$8X10^{-9}$	$3X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$6X10^{-9}$	$4X10^{-5}$
Calcium (20)----------	Ca 45	S	$3X10^{-8}$	$3X10^{-4}$	$1X10^{-9}$	$9X10^{-6}$
		I	$1X10^{-7}$	$5X10^{-3}$	$4X10^{-9}$	$2X10^{-4}$
	Ca 47	S	$2X10^{-7}$	$1X10^{-3}$	$6X10^{-9}$	$5X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$6X10^{-9}$	$3X10^{-5}$
Californium (98)------	Cf 249	S	$2X10^{-12}$	$1X10^{-4}$	$5X10^{-14}$	$4X10^{-6}$
		I	$1X10^{-10}$	$7X10^{-4}$	$3X10^{-12}$	$2X10^{-5}$
	Cf 250	S	$5X10^{-12}$	$4X10^{-4}$	$2X10^{-13}$	$1X10^{-5}$
		I	$1X10^{-10}$	$7X10^{-4}$	$3X10^{-12}$	$3X10^{-5}$
	Cf 251	S	$2X10^{-12}$	$1X10^{-4}$	$6X10^{-14}$	$4X10^{-6}$
		I	$1X10^{-10}$	$8X10^{-4}$	$3X10^{-12}$	$3X10^{-5}$
	Cf 252	S	$2X10^{-11}$	$7X10^{-4}$	$7X10^{-13}$	$2X10^{-5}$
		I	$1X10^{-10}$	$7X10^{-4}$	$4X10^{-12}$	$2X10^{-5}$
	Cf 253	S	$8X10^{-10}$	$4X10^{-3}$	$3X10^{-11}$	$1X10^{-4}$
		I	$8X10^{-10}$	$4X10^{-3}$	$3X10^{-11}$	$1X10^{-4}$
	Cf 254	S	$5X10^{-12}$	$4X10^{-6}$	$2X10^{-13}$	$1X10^{-7}$
		I	$5X10^{-12}$	$4X10^{-6}$	$2X10^{-13}$	$1X10^{-7}$
Carbon (6)------------	C 14	S	$4X10^{-6}$	$2X10^{-2}$	$1X10^{-7}$	$8X10^{-4}$
	(CO_2)	Sub	$5X10^{-5}$	------	$1X10^{-6}$	------
Cerium (58)-----------	Ce 141	S	$4X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$9X10^{-5}$
		I	$2X10^{-7}$	$3X10^{-3}$	$5X10^{-9}$	$9X10^{-5}$
	Ce 143	S	$3X10^{-7}$	$1X10^{-3}$	$9X10^{-9}$	$4X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$7X10^{-9}$	$4X10^{-5}$
	Ce 144	S	$1X10^{-8}$	$3X10^{-4}$	$3X10^{-10}$	$3X10^{-5}$
		I	$6X10^{-9}$	$3X10^{-4}$	$2X10^{-10}$	$1X10^{-5}$

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

/See notes at end of appendix/

Element (atomic number)	Isotope[1]		Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
Cesium (55)-----------	**Cs 131**	**S**	$1X10^{-5}$	$7X10^{-2}$	$4X10^{-7}$	$2X10^{-3}$
		I	$3X10^{-6}$	$3X10^{-2}$	$1X10^{-7}$	$9X10^{-4}$
	Cs 134 m	**S**	$4X10^{-5}$	$2X10^{-1}$	$1X10^{-6}$	$6X10^{-3}$
		I	$6X10^{-6}$	$3X10^{-2}$	$2X10^{-7}$	$1X10^{-3}$
	Cs 134	**S**	$4X10^{-8}$	$3X10^{-4}$	$1X10^{-9}$	$9X10^{-6}$
		I	$1X10^{-8}$	$1X10^{-3}$	$4X10^{-10}$	$4X10^{-5}$
	Cs 135	**S**	$5X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$9X10^{-8}$	$7X10^{-3}$	$3X10^{-9}$	$2X10^{-4}$
	Cs 136	**S**	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$9X10^{-5}$
		I	$2X10^{-7}$	$2X10^{-3}$	$6X10^{-9}$	$6X10^{-5}$
	Cs 137	**S**	$6X10^{-8}$	$4X10^{-4}$	$2X10^{-9}$	$2X10^{-5}$
		I	$1X10^{-8}$	$1X10^{-3}$	$5X10^{-10}$	$4X10^{-5}$
Chlorine (17)---------	**Cl 36**	**S**	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$8X10^{-5}$
		I	$2X10^{-8}$	$2X10^{-3}$	$8X10^{-10}$	$6X10^{-5}$
	Cl 38	**S**	$3X10^{-6}$	$1X10^{-2}$	$9X10^{-8}$	$4X10^{-4}$
		I	$2X10^{-6}$	$1X10^{-2}$	$7X10^{-8}$	$4X10^{-4}$
Chromium (24)---------	**Cr 51**	**S**	$1X10^{-5}$	$5X10^{-2}$	$4X10^{-7}$	$2X10^{-3}$
		I	$2X10^{-6}$	$5X10^{-2}$	$8X10^{-8}$	$2X10^{-3}$
Cobalt (27)-----------	**Co 57**	**S**	$3X10^{-6}$	$2X10^{-2}$	$1X10^{-7}$	$5X10^{-4}$
		I	$2X10^{-7}$	$1X10^{-2}$	$6X10^{-9}$	$4X10^{-4}$
	Co 58 m	**S**	$2X10^{-5}$	$8X10^{-2}$	$6X10^{-7}$	$3X10^{-3}$
		I	$9X10^{-6}$	$6X10^{-2}$	$3X10^{-7}$	$2X10^{-3}$
	Co 58	**S**	$8X10^{-7}$	$4X10^{-3}$	$3X10^{-8}$	$1X10^{-4}$
		I	$5X10^{-8}$	$3X10^{-3}$	$2X10^{-9}$	$9X10^{-5}$
	Co 60	**S**	$3X10^{-7}$	$1X10^{-3}$	$1X10^{-8}$	$5X10^{-5}$
		I	$9X10^{-9}$	$1X10^{-3}$	$3X10^{-10}$	$3X10^{-5}$
Copper (29)-----------	**Cu 64**	**S**	$2X10^{-6}$	$1X10^{-2}$	$7X10^{-8}$	$3X10^{-4}$
		I	$1X10^{-6}$	$6X10^{-3}$	$4X10^{-8}$	$2X10^{-4}$
Curium (96)-----------	**Cm 242**	**S**	$1X10^{-10}$	$7X10^{-4}$	$4X10^{-12}$	$2X10^{-5}$
		I	$2X10^{-10}$	$7X10^{-4}$	$6X10^{-12}$	$3X10^{-5}$
	Cm 243	**S**	$6X10^{-12}$	$1X10^{-4}$	$2X10^{-13}$	$5X10^{-6}$
		I	$1X10^{-10}$	$7X10^{-4}$	$3X10^{-12}$	$2X10^{-5}$
	Cm 244	**S**	$9X10^{-12}$	$2X10^{-4}$	$3X10^{-13}$	$7X10^{-6}$
		I	$1X10^{-10}$	$8X10^{-4}$	$3X10^{-12}$	$3X10^{-5}$
	Cm 245	**S**	$5X10^{-12}$	$1X10^{-4}$	$2X10^{-13}$	$4X10^{-6}$
		I	$1X10^{-10}$	$8X10^{-4}$	$4X10^{-12}$	$3X10^{-5}$
	Cm 246	**S**	$5X10^{-12}$	$1X10^{-4}$	$2X10^{-13}$	$4X10^{-6}$
		I	$1X10^{-10}$	$8X10^{-4}$	$4X10^{-12}$	$3X10^{-5}$
	Cm 247	**S**	$5X10^{-12}$	$1X10^{-4}$	$2X10^{-13}$	$4X10^{-6}$
		I	$1X10^{-10}$	$6X10^{-4}$	$4X10^{-12}$	$2X10^{-5}$
	Cm 248	**S**	$6X10^{-13}$	$1X10^{-5}$	$2X10^{-14}$	$4X10^{-7}$
		I	$1X10^{-11}$	$4X10^{-5}$	$4X10^{-13}$	$1X10^{-6}$
	Cm 249	**S**	$1X10^{-5}$	$6X10^{-2}$	$4X10^{-7}$	$2X10^{-3}$
		I	$1X10^{-5}$	$6X10^{-2}$	$4X10^{-7}$	$2X10^{-3}$

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

[See notes at end of appendix]

Element (atomic number)	Isotope[1]		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
Dysprosium (66)--------	Dy 165	S	$3X10^{-6}$	$1X10^{-2}$	$9X10^{-8}$	$4X10^{-4}$
		I	$2X10^{-6}$	$1X10^{-2}$	$7X10^{-8}$	$4X10^{-4}$
	Dy 166	S	$2X10^{-7}$	$1X10^{-3}$	$8X10^{-9}$	$4X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$7X10^{-9}$	$4X10^{-5}$
Einsteinium (99)-------	Es 253	S	$8X10^{-10}$	$7X10^{-4}$	$3X10^{-11}$	$2X10^{-5}$
		I	$6X10^{-10}$	$7X10^{-4}$	$2X10^{-11}$	$2X10^{-5}$
	Es 254 m	S	$5X10^{-9}$	$5X10^{-4}$	$2X10^{-10}$	$2X10^{-5}$
		I	$6X10^{-9}$	$5X10^{-4}$	$2X10^{-10}$	$2X10^{-5}$
	Es 254	S	$2X10^{-11}$	$4X10^{-4}$	$6X10^{-13}$	$1X10^{-5}$
		I	$1X10^{-10}$	$4X10^{-4}$	$4X10^{-12}$	$1X10^{-5}$
	Es 255	S	$5X10^{-10}$	$8X10^{-4}$	$2X10^{-11}$	$3X10^{-5}$
		I	$4X10^{-10}$	$8X10^{-4}$	$1X10^{-11}$	$3X10^{-5}$
Erbium (68)------------	Er 169	S	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$9X10^{-5}$
		I	$4X10^{-7}$	$3X10^{-3}$	$1X10^{-8}$	$9X10^{-5}$
	Er 171	S	$7X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
Europium (63)----------	Eu 152	S	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$
	(T/2= 9.2 hrs)	I	$3X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$
	Eu 152	S	$1X10^{-8}$	$2X10^{-3}$	$4X10^{-10}$	$8X10^{-5}$
	(T/2=13 yrs)	I	$2X10^{-8}$	$2X10^{-3}$	$6X10^{-10}$	$8X10^{-5}$
	Eu 154	S	$4X10^{-9}$	$6X10^{-4}$	$1X10^{-10}$	$2X10^{-5}$
		I	$7X10^{-9}$	$6X10^{-4}$	$2X10^{-10}$	$2X10^{-5}$
	Eu 155	S	$9X10^{-8}$	$6X10^{-3}$	$3X10^{-9}$	$2X10^{-4}$
		I	$7X10^{-8}$	$6X10^{-3}$	$3X10^{-9}$	$2X10^{-4}$
Fermium (100)----------	Fm 254	S	$6X10^{-8}$	$4X10^{-3}$	$2X10^{-9}$	$1X10^{-4}$
		I	$7X10^{-8}$	$4X10^{-3}$	$2X10^{-9}$	$1X10^{-4}$
	Fm 255	S	$2X10^{-8}$	$1X10^{-3}$	$6X10^{-10}$	$3X10^{-5}$
		I	$1X10^{-8}$	$1X10^{-3}$	$4X10^{-10}$	$3X10^{-5}$
	Fm 256	S	$3X10^{-9}$	$3X10^{-5}$	$1X10^{-10}$	$9X10^{-7}$
		I	$2X10^{-9}$	$3X10^{-5}$	$6X10^{-11}$	$9X10^{-7}$
Fluorine (9)-----------	F 18	S	$5X10^{-6}$	$2X10^{-2}$	$2X10^{-7}$	$8X10^{-4}$
		I	$3X10^{-6}$	$1X10^{-2}$	$9X10^{-8}$	$5X10^{-4}$
Gadolinium (64)--------	Gd 153	S	$2X10^{-7}$	$6X10^{-3}$	$8X10^{-9}$	$2X10^{-4}$
		I	$9X10^{-8}$	$6X10^{-3}$	$3X10^{-9}$	$2X10^{-4}$
	Gd 159	S	$5X10^{-7}$	$2X10^{-3}$	$2X10^{-8}$	$8X10^{-5}$
		I	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$8X10^{-5}$
Gallium (31)-----------	Ga 72	S	$2X10^{-7}$	$1X10^{-3}$	$8X10^{-9}$	$4X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$6X10^{-9}$	$4X10^{-5}$
Germanium (32)---------	Ge 71	S	$1X10^{-5}$	$5X10^{-2}$	$4X10^{-7}$	$2X10^{-3}$
		I	$6X10^{-6}$	$5X10^{-2}$	$2X10^{-7}$	$2X10^{-3}$
Gold (79)--------------	Au 196	S	$1X10^{-6}$	$5X10^{-3}$	$4X10^{-8}$	$2X10^{-4}$
		I	$6X10^{-7}$	$4X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
	Au 198	S	$3X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$5X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$8X10^{-9}$	$5X10^{-5}$
	Au 199	S	$1X10^{-6}$	$5X10^{-3}$	$4X10^{-8}$	$2X10^{-4}$
		I	$8X10^{-7}$	$4X10^{-3}$	$3X10^{-8}$	$2X10^{-4}$

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

[See notes at end of appendix]

Element (atomic number)	Isotope[1]		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
Hafnium (72)-----------	Hf 181	S	4X10^{-8}	2X10^{-3}	1X10^{-9}	7X10^{-5}
		I	7X10^{-8}	2X10^{-3}	3X10^{-9}	7X10^{-5}
Holmium (67)-----------	Ho 166	S	2X10^{-7}	9X10^{-4}	7X10^{-9}	3X10^{-5}
		I	2X10^{-7}	9X10^{-4}	6X10^{-9}	3X10^{-5}
Hydrogen (1)-----------	H 3	S	5X10^{-6}	1X10^{-1}	2X10^{-7}	3X10^{-3}
		I	5X10^{-6}	1X10^{-1}	2X10^{-7}	3X10^{-3}
		Sub	2X10^{-3}	------	4X10^{-5}	------
Indium (49)------------	In 113 m	S	8X10^{-6}	4X10^{-2}	3X10^{-7}	1X10^{-3}
		I	7X10^{-6}	4X10^{-2}	2X10^{-7}	1X10^{-3}
	In 114 m	S	1X10^{-7}	5X10^{-4}	4X10^{-9}	2X10^{-5}
		I	2X10^{-8}	5X10^{-4}	7X10^{-10}	2X10^{-5}
	In 115 m	S	2X10^{-6}	1X10^{-2}	8X10^{-8}	4X10^{-4}
		I	2X10^{-6}	1X10^{-2}	6X10^{-8}	4X10^{-4}
	In 115	S	2X10^{-7}	3X10^{-3}	9X10^{-9}	9X10^{-5}
		I	3X10^{-8}	3X10^{-3}	1X10^{-9}	9X10^{-5}
Iodine (53)------------	I 125	S	5X10^{-9}	4X10^{-5}	8X10^{-11}	2X10^{-7}
		I	2X10^{-7}	6X10^{-3}	6X10^{-9}	2X10^{-4}
	I 126	S	8X10^{-9}	5X10^{-5}	9X10^{-11}	3X10^{-7}
		I	3X10^{-7}	3X10^{-3}	1X10^{-8}	9X10^{-5}
	I 129	S	2X10^{-9}	1X10^{-5}	2X10^{-11}	6X10^{-8}
		I	7X10^{-8}	6X10^{-3}	2X10^{-9}	2X10^{-4}
	I 131	S	9X10^{-9}	6X10^{-5}	1X10^{-10}	3X10^{-7}
		I	3X10^{-7}	2X10^{-3}	1X10^{-8}	6X10^{-5}
	I 132	S	2X10^{-7}	2X10^{-3}	3X10^{-9}	8X10^{-6}
		I	9X10^{-7}	5X10^{-3}	3X10^{-8}	2X10^{-4}
	I 133	S	3X10^{-8}	2X10^{-4}	4X10^{-10}	1X10^{-6}
		I	2X10^{-7}	1X10^{-3}	7X10^{-9}	4X10^{-5}
	I 134	S	5X10^{-7}	4X10^{-3}	6X10^{-9}	2X10^{-5}
		I	3X10^{-6}	2X10^{-2}	1X10^{-7}	6X10^{-4}
	I 135	S	1X10^{-7}	7X10^{-4}	1X10^{-9}	4X10^{-6}
		I	4X10^{-7}	2X10^{-3}	1X10^{-8}	7X10^{-5}
Iridium (77)-----------	Ir 190	S	1X10^{-6}	6X10^{-3}	4X10^{-8}	2X10^{-4}
		I	4X10^{-7}	5X10^{-3}	1X10^{-8}	2X10^{-4}
	Ir 192	S	1X10^{-7}	1X10^{-3}	4X10^{-9}	4X10^{-5}
		I	3X10^{-8}	1X10^{-3}	9X10^{-10}	4X10^{-5}
	Ir 194	S	2X10^{-7}	1X10^{-3}	8X10^{-9}	3X10^{-5}
		I	2X10^{-7}	9X10^{-4}	5X10^{-9}	3X10^{-5}
Iron (26)--------------	Fe 55	S	9X10^{-7}	2X10^{-2}	3X10^{-8}	8X10^{-4}
		I	1X10^{-6}	7X10^{-2}	3X10^{-8}	2X10^{-3}
	Fe 59	S	1X10^{-7}	2X10^{-3}	5X10^{-9}	6X10^{-5}
		I	5X10^{-8}	2X10^{-3}	2X10^{-9}	5X10^{-5}

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

[See notes at end of appendix]

			Table I		Table II	
Element (atomic number)	Isotope[1]		Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
Krypton (36)----------	Kr 85 m	Sub	$6X10^{-6}$	------	$1X10^{-7}$	------
	Kr 85	Sub	$1X10^{-5}$	------	$3X10^{-7}$	------
	Kr 87	Sub	$1X10^{-6}$	------	$2X10^{-8}$	------
	Kr 88	Sub	$1X10^{-6}$	------	$2X10^{-8}$	------
Lanthanum (57)--------	La 140	S	$2X10^{-7}$	$7X10^{-4}$	$5X10^{-9}$	$2X10^{-5}$
		I	$1X10^{-7}$	$7X10^{-4}$	$4X10^{-9}$	$2X10^{-5}$
Lead (82)-------------	Pb 203	S	$3X10^{-6}$	$1X10^{-2}$	$9X10^{-8}$	$4X10^{-4}$
		I	$2X10^{-6}$	$1X10^{-2}$	$6X10^{-8}$	$4X10^{-4}$
	Pb 210	S	$1X10^{-10}$	$4X10^{-6}$	$4X10^{-12}$	$1X10^{-7}$
		I	$2X10^{-10}$	$5X10^{-3}$	$8X10^{-12}$	$2X10^{-4}$
	Pb 212	S	$2X10^{-8}$	$6X10^{-4}$	$6X10^{-10}$	$2X10^{-5}$
		I	$2X10^{-8}$	$5X10^{-4}$	$7X10^{-10}$	$2X10^{-5}$
Lutetium (71)---------	Lu 177	S	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$5X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
Manganese (25)--------	Mn 52	S	$2X10^{-7}$	$1X10^{-3}$	$7X10^{-9}$	$3X10^{-5}$
		I	$1X10^{-7}$	$9X10^{-4}$	$5X10^{-9}$	$3X10^{-5}$
	Mn 54	S	$4X10^{-7}$	$4X10^{-3}$	$1X10^{-9}$	$1X10^{-4}$
		I	$4X10^{-8}$	$3X10^{-3}$	$1X10^{-9}$	$1X10^{-4}$
	Mn 56	S	$8X10^{-7}$	$4X10^{-3}$	$3X10^{-8}$	$1X10^{-4}$
		I	$5X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
Mercury (80)----------	Hg 197 m	S	$7X10^{-7}$	$6X10^{-3}$	$3X10^{-8}$	$2X10^{-4}$
		I	$8X10^{-7}$	$5X10^{-3}$	$3X10^{-8}$	$2X10^{-4}$
	Hg 197	S	$1X10^{-6}$	$9X10^{-3}$	$4X10^{-8}$	$3X10^{-4}$
		I	$3X10^{-6}$	$1X10^{-2}$	$9X10^{-8}$	$5X10^{-4}$
	Hg 203	S	$7X10^{-8}$	$5X10^{-4}$	$2X10^{-9}$	$2X10^{-5}$
		I	$1X10^{-7}$	$3X10^{-3}$	$4X10^{-9}$	$1X10^{-4}$
Molybdenum (42)-------	Mo 99	S	$7X10^{-7}$	$5X10^{-3}$	$3X10^{-8}$	$2X10^{-4}$
		I	$2X10^{-7}$	$1X10^{-3}$	$7X10^{-9}$	$4X10^{-5}$
Neodymium (60)--------	Nd 144	S	$8X10^{-11}$	$2X10^{-3}$	$3X10^{-12}$	$7X10^{-5}$
		I	$3X10^{-10}$	$2X10^{-3}$	$1X10^{-11}$	$8X10^{-5}$
	Nd 147	S	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$
		I	$2X10^{-7}$	$2X10^{-3}$	$8X10^{-9}$	$6X10^{-5}$
	Nd 149	S	$2X10^{-6}$	$8X10^{-3}$	$6X10^{-8}$	$3X10^{-4}$
		I	$1X10^{-6}$	$8X10^{-3}$	$5X10^{-8}$	$3X10^{-4}$
Neptunium (93)--------	Np 237	S	$4X10^{-12}$	$9X10^{-5}$	$1X10^{-13}$	$3X10^{-6}$
		I	$1X10^{-10}$	$9X10^{-4}$	$4X10^{-12}$	$3X10^{-5}$
	Np 239	S	$8X10^{-7}$	$4X10^{-3}$	$3X10^{-8}$	$1X10^{-4}$
		I	$7X10^{-7}$	$4X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
Nickel (28)-----------	Ni 59	S	$5X10^{-7}$	$6X10^{-3}$	$2X10^{-8}$	$2X10^{-4}$
		I	$8X10^{-7}$	$6X10^{-2}$	$3X10^{-8}$	$2X10^{-3}$
	Ni 63	S	$6X10^{-8}$	$8X10^{-4}$	$2X10^{-9}$	$3X10^{-5}$
		I	$3X10^{-7}$	$2X10^{-2}$	$1X10^{-8}$	$7X10^{-4}$
	Ni 65	S	$9X10^{-7}$	$4X10^{-3}$	$3X10^{-8}$	$1X10^{-4}$
		I	$5X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

(See notes at end of appendix)

Element (atomic number)	Isotope[1]		Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
Niobium (Columbium)(41)	Nb 93 m	S	$1X10^{-7}$	$1X10^{-2}$	$4X10^{-9}$	$4X10^{-4}$
		I	$2X10^{-7}$	$1X10^{-2}$	$5X10^{-9}$	$4X10^{-4}$
	Nb 95	S	$5X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$1X10^{-7}$	$3X10^{-3}$	$3X10^{-9}$	$1X10^{-4}$
	Nb 97	S	$6X10^{-6}$	$3X10^{-2}$	$2X10^{-7}$	$9X10^{-4}$
		I	$5X10^{-6}$	$3X10^{-2}$	$2X10^{-7}$	$9X10^{-4}$
Osmium (76)-----------	Os 185	S	$5X10^{-7}$	$2X10^{-3}$	$2X10^{-8}$	$7X10^{-5}$
		I	$5X10^{-8}$	$2X10^{-3}$	$2X10^{-9}$	$7X10^{-5}$
	Os 191 m	S	$2X10^{-5}$	$7X10^{-2}$	$6X10^{-7}$	$3X10^{-3}$
		I	$9X10^{-6}$	$7X10^{-2}$	$3X10^{-7}$	$2X10^{-3}$
	Os 191	S	$1X10^{-6}$	$5X10^{-3}$	$4X10^{-8}$	$2X10^{-4}$
		I	$4X10^{-7}$	$5X10^{-3}$	$1X10^{-8}$	$2X10^{-4}$
	Os 193	S	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$
		I	$3X10^{-7}$	$2X10^{-3}$	$9X10^{-9}$	$5X10^{-5}$
Palladium (46)--------	Pd 103	S	$1X10^{-6}$	$1X10^{-2}$	$5X10^{-8}$	$3X10^{-4}$
		I	$7X10^{-7}$	$8X10^{-3}$	$3X10^{-8}$	$3X10^{-4}$
	Pd 109	S	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$9X10^{-5}$
		I	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$7X10^{-5}$
Phosphorus (15)-------	P 32	S	$7X10^{-8}$	$5X10^{-4}$	$2X10^{-9}$	$2X10^{-5}$
		I	$8X10^{-8}$	$7X10^{-4}$	$3X10^{-9}$	$2X10^{-5}$
Platinum (78)---------	Pt 191	S	$8X10^{-7}$	$4X10^{-3}$	$3X10^{-8}$	$1X10^{-4}$
		I	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
	Pt 193 m	S	$7X10^{-6}$	$3X10^{-2}$	$2X10^{-7}$	$1X10^{-3}$
		I	$5X10^{-6}$	$3X10^{-2}$	$2X10^{-7}$	$1X10^{-3}$
	Pt 197 m	S	$6X10^{-6}$	$3X10^{-2}$	$2X10^{-7}$	$1X10^{-3}$
		I	$5X10^{-6}$	$3X10^{-2}$	$2X10^{-7}$	$9X10^{-4}$
	Pt 197	S	$8X10^{-7}$	$4X10^{-3}$	$3X10^{-8}$	$1X10^{-4}$
		I	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
Plutonium (94)--------	Pu 238	S	$2X10^{-12}$	$1X10^{-4}$	$7X10^{-14}$	$5X10^{-6}$
		I	$3X10^{-11}$	$8X10^{-4}$	$1X10^{-12}$	$3X10^{-5}$
	Pu 239	S	$2X10^{-12}$	$1X10^{-4}$	$6X10^{-14}$	$5X10^{-6}$
		I	$4X10^{-11}$	$8X10^{-4}$	$1X10^{-12}$	$3X10^{-5}$
	Pu 240	S	$2X10^{-12}$	$1X10^{-4}$	$6X10^{-14}$	$5X10^{-6}$
		I	$4X10^{-11}$	$8X10^{-4}$	$1X10^{-12}$	$3X10^{-5}$
	Pu 241	S	$9X10^{-11}$	$7X10^{-3}$	$3X10^{-12}$	$2X10^{-4}$
		I	$4X10^{-8}$	$4X10^{-2}$	$1X10^{-9}$	$1X10^{-3}$
	Pu 242	S	$2X10^{-12}$	$1X10^{-4}$	$6X10^{-14}$	$5X10^{-6}$
		I	$4X10^{-11}$	$9X10^{-4}$	$1X10^{-12}$	$3X10^{-5}$
	Pu 243	S	$2X10^{-6}$	$1X10^{-2}$	$6X10^{-8}$	$3X10^{-4}$
		I	$2X10^{-6}$	$1X10^{-2}$	$8X10^{-8}$	$3X10^{-4}$
	Pu 244	S	$2X10^{-12}$	$1X10^{-4}$	$6X10^{-14}$	$4X10^{-6}$
		I	$3X10^{-11}$	$3X10^{-4}$	$1X10^{-12}$	$1X10^{-5}$
Polonium (84)---------	Po 210	S	$5X10^{-10}$	$2X10^{-5}$	$2X10^{-11}$	$7X10^{-7}$
		I	$2X10^{-10}$	$8X10^{-4}$	$7X10^{-12}$	$3X10^{-5}$

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

[See notes at end of appendix]

Element (atomic number)	Isotope[1]		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
Potassium (19)--------	K 42	S	$2X10^{-6}$	$9X10^{-3}$	$7X10^{-8}$	$3X10^{-4}$
		I	$1X10^{-7}$	$6X10^{-4}$	$4X10^{-9}$	$2X10^{-5}$
Praseodymium (59)-----	Pr 142	S	$2X10^{-7}$	$9X10^{-4}$	$7X10^{-9}$	$3X10^{-5}$
		I	$2X10^{-7}$	$9X10^{-4}$	$5X10^{-9}$	$3X10^{-5}$
	Pr 143	S	$3X10^{-7}$	$1X10^{-3}$	$1X10^{-8}$	$5X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$6X10^{-9}$	$5X10^{-5}$
Promethium (61)-------	Pm 147	S	$6X10^{-8}$	$6X10^{-3}$	$2X10^{-9}$	$2X10^{-4}$
		I	$1X10^{-7}$	$6X10^{-3}$	$3X10^{-9}$	$2X10^{-4}$
	Pm 149	S	$3X10^{-7}$	$1X10^{-3}$	$1X10^{-8}$	$4X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$8X10^{-9}$	$4X10^{-5}$
Protoactinium (91)----	Pa 230	S	$2X10^{-9}$	$7X10^{-3}$	$6X10^{-11}$	$2X10^{-4}$
		I	$8X10^{-10}$	$7X10^{-3}$	$3X10^{-11}$	$2X10^{-4}$
	Pa 231	S	$1X10^{-12}$	$3X10^{-5}$	$4X10^{-14}$	$9X10^{-7}$
		I	$1X10^{-10}$	$8X10^{-4}$	$4X10^{-12}$	$2X10^{-5}$
	Pa 233	S	$6X10^{-7}$	$4X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$2X10^{-7}$	$3X10^{-3}$	$6X10^{-9}$	$1X10^{-4}$
Radium (88)-----------	Ra 223	S	$2X10^{-9}$	$2X10^{-5}$	$6X10^{-11}$	$7X10^{-7}$
		I	$2X10^{-10}$	$1X10^{-4}$	$8X10^{-12}$	$4X10^{-6}$
	Ra 224	S	$5X10^{-9}$	$7X10^{-5}$	$2X10^{-10}$	$2X10^{-6}$
		I	$7X10^{-10}$	$2X10^{-4}$	$2X10^{-11}$	$5X10^{-6}$
	Ra 226	S	$3X10^{-11}$	$4X10^{-7}$	$3X10^{-12}$	$3X10^{-8}$
		I	$5X10^{-11}$	$9X10^{-4}$	$2X10^{-12}$	$3X10^{-5}$
	Ra 228	S	$7X10^{-11}$	$8X10^{-7}$	$2X10^{-12}$	$3X10^{-8}$
		I	$4X10^{-11}$	$7X10^{-4}$	$1X10^{-12}$	$3X10^{-5}$
Radon (86)------------	Rn 220	S	$3X10^{-7}$	------	$1X10^{-8}$	------
		I	------	------	------	------
	Rn 222	S	$1X10^{-7}$	------	$3X10^{-9}$	------
Rhenium (75)----------	Re 183	S	$3X10^{-6}$	$2X10^{-2}$	$9X10^{-8}$	$6X10^{-4}$
		I	$2X10^{-7}$	$8X10^{-3}$	$5X10^{-9}$	$3X10^{-4}$
	Re 186	S	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$9X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$8X10^{-9}$	$5X10^{-5}$
	Re 187	S	$9X10^{-6}$	$7X10^{-2}$	$3X10^{-7}$	$3X10^{-3}$
		I	$5X10^{-7}$	$4X10^{-2}$	$2X10^{-8}$	$2X10^{-3}$
	Re 188	S	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$
		I	$2X10^{-7}$	$9X10^{-4}$	$6X10^{-9}$	$3X10^{-5}$
Rhodium (45)----------	Rh 103 m	S	$8X10^{-5}$	$4X10^{-1}$	$3X10^{-6}$	$1X10^{-2}$
		I	$6X10^{-5}$	$3X10^{-1}$	$2X10^{-6}$	$1X10^{-2}$
	Rh 105	S	$8X10^{-7}$	$4X10^{-3}$	$3X10^{-8}$	$1X10^{-4}$
		I	$5X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
Rubidium (37)---------	Rb 86	S	$3X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$7X10^{-5}$
		I	$7X10^{-8}$	$7X10^{-4}$	$2X10^{-9}$	$2X10^{-5}$
	Rb 87	S	$5X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$7X10^{-8}$	$5X10^{-3}$	$2X10^{-9}$	$2X10^{-4}$

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

[See notes at end of appendix]

Element (atomic number)	Isotope[1]		Table I Column 1 Air (uc/ml)	Table I Column 2 Water (uc/ml)	Table II Column 1 Air (uc/ml)	Table II Column 2 Water (uc/ml)
Ruthenium (44)---------	Ru 97	S	$2X10^{-6}$	$1X10^{-2}$	$8X10^{-8}$	$4X10^{-4}$
		I	$2X10^{-6}$	$1X10^{-2}$	$6X10^{-8}$	$3X10^{-4}$
	Ru 103	S	$5X10^{-7}$	$2X10^{-3}$	$2X10^{-8}$	$8X10^{-5}$
		I	$8X10^{-8}$	$2X10^{-3}$	$3X10^{-9}$	$8X10^{-5}$
	Ru 105	S	$7X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$5X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
	Ru 106	S	$8X10^{-8}$	$4X10^{-4}$	$3X10^{-9}$	$1X10^{-5}$
		I	$6X10^{-9}$	$3X10^{-4}$	$2X10^{-10}$	$1X10^{-5}$
Samarium (62)----------	Sm 147	S	$7X10^{-11}$	$2X10^{-3}$	$2X10^{-12}$	$6X10^{-5}$
		I	$3X10^{-10}$	$2X10^{-3}$	$9X10^{-12}$	$7X10^{-5}$
	Sm 151	S	$6X10^{-8}$	$1X10^{-2}$	$2X10^{-9}$	$4X10^{-4}$
		I	$1X10^{-7}$	$1X10^{-2}$	$5X10^{-9}$	$4X10^{-4}$
	Sm 153	S	$5X10^{-7}$	$2X10^{-3}$	$2X10^{-8}$	$8X10^{-5}$
		I	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$8X10^{-5}$
Scandium (21)----------	Sc 46	S	$2X10^{-7}$	$1X10^{-3}$	$8X10^{-9}$	$4X10^{-5}$
		I	$2X10^{-8}$	$1X10^{-3}$	$8X10^{-10}$	$4X10^{-5}$
	Sc 47	S	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$9X10^{-5}$
		I	$5X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$9X10^{-5}$
	Sc 48	S	$2X10^{-7}$	$8X10^{-4}$	$6X10^{-9}$	$3X10^{-5}$
		I	$1X10^{-7}$	$8X10^{-4}$	$5X10^{-9}$	$3X10^{-5}$
Selenium (34)----------	Se 75	S	$1X10^{-6}$	$9X10^{-3}$	$4X10^{-8}$	$3X10^{-4}$
		I	$1X10^{-7}$	$8X10^{-3}$	$4X10^{-9}$	$3X10^{-4}$
Silicon (14)-----------	Si 31	S	$6X10^{-6}$	$3X10^{-2}$	$2X10^{-7}$	$9X10^{-4}$
		I	$1X10^{-6}$	$6X10^{-3}$	$3X10^{-8}$	$2X10^{-4}$
Silver (47)------------	Ag 105	S	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$8X10^{-8}$	$3X10^{-3}$	$3X10^{-9}$	$1X10^{-4}$
	Ag 110 m	S	$2X10^{-7}$	$9X10^{-4}$	$7X10^{-9}$	$3X10^{-5}$
		I	$1X10^{-8}$	$9X10^{-4}$	$3X10^{-10}$	$3X10^{-5}$
	Ag 111	S	$3X10^{-7}$	$1X10^{-3}$	$1X10^{-8}$	$4X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$8X10^{-9}$	$4X10^{-5}$
Sodium (11)------------	Na 22	S	$2X10^{-7}$	$1X10^{-3}$	$6X10^{-9}$	$4X10^{-5}$
		I	$9X10^{-9}$	$9X10^{-4}$	$3X10^{-10}$	$3X10^{-5}$
	Na 24	S	$1X10^{-6}$	$6X10^{-3}$	$4X10^{-8}$	$2X10^{-4}$
		I	$1X10^{-7}$	$8X10^{-4}$	$5X10^{-9}$	$3X10^{-5}$
Strontium (38)---------	Sr 85 m	S	$4X10^{-5}$	$2X10^{-1}$	$1X10^{-6}$	$7X10^{-3}$
		I	$3X10^{-5}$	$2X10^{-1}$	$1X10^{-6}$	$7X10^{-3}$
	Sr 85	S	$2X10^{-7}$	$3X10^{-3}$	$8X10^{-9}$	$1X10^{-4}$
		I	$1X10^{-7}$	$5X10^{-3}$	$4X10^{-9}$	$2X10^{-4}$
	Sr 89	S	$3X10^{-8}$	$3X10^{-4}$	$3X10^{-10}$	$3X10^{-6}$
		I	$4X10^{-8}$	$8X10^{-4}$	$1X10^{-9}$	$3X10^{-5}$
	Sr 90	S	$1X10^{-9}$	$1X10^{-5}$	$3X10^{-11}$	$3X10^{-7}$
		I	$5X10^{-9}$	$1X10^{-3}$	$2X10^{-10}$	$4X10^{-5}$
	Sr 91	S	$4X10^{-7}$	$2X10^{-3}$	$2X10^{-8}$	$7X10^{-5}$
		I	$3X10^{-7}$	$1X10^{-3}$	$9X10^{-9}$	$5X10^{-5}$
	Sr 92	S	$4X10^{-7}$	$2X10^{-3}$	$2X10^{-8}$	$7X10^{-5}$
		I	$3X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

[See notes at end of appendix]

Element (atomic number)	Isotope[1]		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
Sulfur (16)------------	S 35	S	$3X10^{-7}$	$2X10^{-3}$	$9X10^{-9}$	$6X10^{-5}$
		I	$3X10^{-7}$	$8X10^{-3}$	$9X10^{-9}$	$3X10^{-4}$
Tantalum (73)---------	Ta 182	S	$4X10^{-8}$	$1X10^{-3}$	$1X10^{-9}$	$4X10^{-5}$
		I	$2X10^{-8}$	$1X10^{-3}$	$7X10^{-10}$	$4X10^{-5}$
Technetium (43)-------	Tc 96 m	S	$8X10^{-5}$	$4X10^{-1}$	$3X10^{-6}$	$1X10^{-2}$
		I	$3X10^{-5}$	$3X10^{-1}$	$1X10^{-6}$	$1X10^{-2}$
	Tc 96	S	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$2X10^{-7}$	$1X10^{-3}$	$8X10^{-9}$	$5X10^{-5}$
	Tc 97 m	S	$2X10^{-6}$	$1X10^{-2}$	$8X10^{-8}$	$4X10^{-4}$
		I	$2X10^{-7}$	$5X10^{-3}$	$5X10^{-9}$	$2X10^{-4}$
	Tc 97	S	$1X10^{-5}$	$5X10^{-2}$	$4X10^{-7}$	$2X10^{-3}$
		I	$3X10^{-7}$	$2X10^{-2}$	$1X10^{-8}$	$8X10^{-4}$
	Tc 99 m	S	$4X10^{-5}$	$2X10^{-1}$	$1X10^{-6}$	$6X10^{-3}$
		I	$1X10^{-5}$	$8X10^{-2}$	$5X10^{-7}$	$3X10^{-3}$
	Tc 99	S	$2X10^{-6}$	$1X10^{-2}$	$7X10^{-8}$	$3X10^{-4}$
		I	$6X10^{-8}$	$5X10^{-3}$	$2X10^{-9}$	$2X10^{-4}$
Tellurium (52)--------	Te 125 m	S	$4X10^{-7}$	$5X10^{-3}$	$1X10^{-8}$	$2X10^{-4}$
		I	$1X10^{-7}$	$3X10^{-3}$	$4X10^{-9}$	$1X10^{-4}$
	Te 127 m	S	$1X10^{-7}$	$2X10^{-3}$	$5X10^{-9}$	$6X10^{-5}$
		I	$4X10^{-8}$	$2X10^{-3}$	$1X10^{-9}$	$5X10^{-5}$
	Te 127	S	$2X10^{-6}$	$8X10^{-3}$	$6X10^{-8}$	$3X10^{-4}$
		I	$9X10^{-7}$	$5X10^{-3}$	$3X10^{-8}$	$2X10^{-4}$
	Te 129 m	S	$8X10^{-8}$	$1X10^{-3}$	$3X10^{-9}$	$3X10^{-5}$
		I	$3X10^{-8}$	$6X10^{-4}$	$1X10^{-9}$	$2X10^{-5}$
	Te 129	S	$5X10^{-6}$	$2X10^{-2}$	$2X10^{-7}$	$8X10^{-4}$
		I	$4X10^{-6}$	$2X10^{-2}$	$1X10^{-7}$	$8X10^{-4}$
	Te 131 m	S	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$6X10^{-9}$	$4X10^{-5}$
	Te 132	S	$2X10^{-7}$	$9X10^{-4}$	$7X10^{-9}$	$3X10^{-5}$
		I	$1X10^{-7}$	$6X10^{-4}$	$4X10^{-9}$	$2X10^{-5}$
Terbium (65)----------	Tb 160	S	$1X10^{-7}$	$1X10^{-3}$	$3X10^{-9}$	$4X10^{-5}$
		I	$3X10^{-8}$	$1X10^{-3}$	$1X10^{-9}$	$4X10^{-5}$
Thallium (81)---------	Tl 200	S	$3X10^{-6}$	$1X10^{-2}$	$9X10^{-8}$	$4X10^{-4}$
		I	$1X10^{-6}$	$7X10^{-3}$	$4X10^{-8}$	$2X10^{-4}$
	Tl 201	S	$2X10^{-6}$	$9X10^{-3}$	$7X10^{-8}$	$3X10^{-4}$
		I	$9X10^{-7}$	$5X10^{-3}$	$3X10^{-8}$	$2X10^{-4}$
	Tl 202	S	$8X10^{-7}$	$4X10^{-3}$	$3X10^{-8}$	$1X10^{-4}$
		I	$2X10^{-7}$	$2X10^{-3}$	$8X10^{-9}$	$7X10^{-5}$
	Tl 204	S	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$3X10^{-8}$	$2X10^{-3}$	$9X10^{-10}$	$6X10^{-5}$

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

[See notes at end of appendix]

Element (atomic number)	Isotope[1]		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
Thorium (90)-----------	Th 228	S	$9X10^{-12}$	$2X10^{-4}$	$3X10^{-13}$	$7X10^{-6}$
		I	$6X10^{-12}$	$4X10^{-4}$	$2X10^{-13}$	$1X10^{-5}$
	Th 230	S	$2X10^{-12}$	$5X10^{-5}$	$8X10^{-14}$	$2X10^{-6}$
		I	$1X10^{-11}$	$9X10^{-4}$	$3X10^{-13}$	$3X10^{-5}$
	Th 232	S	$3X10^{-11}$	$5X10^{-5}$	$1X10^{-12}$	$2X10^{-6}$
		I	$3X10^{-11}$	$1X10^{-3}$	$1X10^{-12}$	$4X10^{-5}$
	Th natural	S	$3X10^{-11}$	$3X10^{-5}$	$1X10^{-12}$	$1X10^{-6}$
		I	$3X10^{-11}$	$3X10^{-4}$	$1X10^{-12}$	$1X10^{-5}$
	Th 234	S	$6X10^{-8}$	$5X10^{-4}$	$2X10^{-9}$	$2X10^{-5}$
		I	$3X10^{-8}$	$5X10^{-4}$	$1X10^{-9}$	$2X10^{-5}$
Thulium (69)-----------	Tm 170	S	$4X10^{-8}$	$1X10^{-3}$	$1X10^{-9}$	$5X10^{-5}$
		I	$3X10^{-8}$	$1X10^{-3}$	$1X10^{-9}$	$5X10^{-5}$
	Tm 171	S	$1X10^{-7}$	$1X10^{-2}$	$4X10^{-9}$	$5X10^{-4}$
		I	$2X10^{-7}$	$1X10^{-2}$	$8X10^{-9}$	$5X10^{-4}$
Tin (50)---------------	Sn 113	S	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$9X10^{-5}$
		I	$5X10^{-8}$	$2X10^{-3}$	$2X10^{-9}$	$8X10^{-5}$
	Sn 125	S	$1X10^{-7}$	$5X10^{-4}$	$4X10^{-9}$	$2X10^{-5}$
		I	$8X10^{-8}$	$5X10^{-4}$	$3X10^{-9}$	$2X10^{-5}$
Tungsten (Wolfram)(74)-	W 181	S	$2X10^{-6}$	$1X10^{-2}$	$8X10^{-8}$	$4X10^{-4}$
		I	$1X10^{-7}$	$1X10^{-2}$	$4X10^{-9}$	$3X10^{-4}$
	W 185	S	$8X10^{-7}$	$4X10^{-3}$	$3X10^{-8}$	$1X10^{-4}$
		I	$1X10^{-7}$	$3X10^{-3}$	$4X10^{-9}$	$1X10^{-4}$
	W 187	S	$4X10^{-7}$	$2X10^{-3}$	$2X10^{-8}$	$7X10^{-5}$
		I	$3X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$
Uranium (92)-----------	U 230	S	$3X10^{-10}$	$1X10^{-4}$	$1X10^{-11}$	$5X10^{-6}$
		I	$1X10^{-10}$	$1X10^{-4}$	$4X10^{-12}$	$5X10^{-6}$
	U 232	S	$1X10^{-10}$	$8X10^{-4}$	$3X10^{-12}$	$3X10^{-5}$
		I	$3X10^{-11}$	$8X10^{-4}$	$9X10^{-13}$	$3X10^{-5}$
	U 233	S	$5X10^{-10}$	$9X10^{-4}$	$2X10^{-11}$	$3X10^{-5}$
		I	$1X10^{-10}$	$9X10^{-4}$	$4X10^{-12}$	$3X10^{-5}$
	U 234	S	$6X10^{-10}$	$9X10^{-4}$	$2X10^{-11}$	$3X10^{-5}$
		I	$1X10^{-10}$	$9X10^{-4}$	$4X10^{-12}$	$3X10^{-5}$
	U 235	S	$5X10^{-10}$	$8X10^{-4}$	$2X10^{-11}$	$3X10^{-5}$
		I	$1X10^{-10}$	$8X10^{-4}$	$4X10^{-12}$	$3X10^{-5}$
	U 236	S	$6X10^{-10}$	$1X10^{-3}$	$2X10^{-11}$	$3X10^{-5}$
		I	$1X10^{-10}$	$1X10^{-3}$	$4X10^{-12}$	$3X10^{-5}$
	U 238	S	$7X10^{-11}$	$1X10^{-3}$	$3X10^{-12}$	$4X10^{-5}$
		I	$1X10^{-10}$	$1X10^{-3}$	$5X10^{-12}$	$4X10^{-5}$
	U 240	S	$2X10^{-7}$	$1X10^{-3}$	$8X10^{-9}$	$3X10^{-5}$
		I	$2X10^{-7}$	$1X10^{-3}$	$6X10^{-9}$	$3X10^{-5}$
	U natural	S	$7X10^{-11}$	$5X10^{-4}$	$3X10^{-12}$	$2X10^{-5}$
		I	$6X10^{-11}$	$5X10^{-4}$	$2X10^{-12}$	$2X10^{-5}$
Vanadium (23)----------	V 48	S	$2X10^{-7}$	$9X10^{-4}$	$6X10^{-9}$	$3X10^{-5}$
		I	$6X10^{-8}$	$8X10^{-4}$	$2X10^{-9}$	$3X10^{-5}$

See footnotes at end of table.

APPENDIX A

CONCENTRATIONS IN AIR AND WATER ABOVE NATURAL BACKGROUND--Continued

/See notes at end of appendix/

Element (atomic number)	Isotope[1]		Table I		Table II	
			Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
Xenon (54)------------	Xe 131 m	Sub	$2X10^{-5}$	------	$4X10^{-7}$	------
	Xe 133 m	Sub	$1X10^{-5}$	------	$3X10^{-7}$	------
	Xe 133	Sub	$1X10^{-5}$	------	$3X10^{-7}$	------
	Xe 135	Sub	$4X10^{-6}$	------	$1X10^{-7}$	------
Ytterbium (70)--------	Yb 175	S	$7X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
		I	$6X10^{-7}$	$3X10^{-3}$	$2X10^{-8}$	$1X10^{-4}$
Yttrium (39)----------	Y 90	S	$1X10^{-7}$	$6X10^{-4}$	$4X10^{-9}$	$2X10^{-5}$
		I	$1X10^{-7}$	$6X10^{-4}$	$3X10^{-9}$	$2X10^{-5}$
	Y 91 m	S	$2X10^{-5}$	$1X10^{-1}$	$8X10^{-7}$	$3X10^{-3}$
		I	$2X10^{-5}$	$1X10^{-1}$	$6X10^{-7}$	$3X10^{-3}$
	Y 91	S	$4X10^{-8}$	$8X10^{-4}$	$1X10^{-9}$	$3X10^{-5}$
		I	$3X10^{-8}$	$8X10^{-4}$	$1X10^{-9}$	$3X10^{-5}$
	Y 92	S	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$
		I	$3X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$
	Y 93	S	$2X10^{-7}$	$8X10^{-4}$	$6X10^{-9}$	$3X10^{-5}$
		I	$1X10^{-7}$	$8X10^{-4}$	$5X10^{-9}$	$3X10^{-5}$
Zinc (30)-------------	Zn 65	S	$1X10^{-7}$	$3X10^{-3}$	$4X10^{-9}$	$1X10^{-4}$
		I	$6X10^{-8}$	$5X10^{-3}$	$2X10^{-9}$	$2X10^{-4}$
	Zn 69 m	S	$4X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$7X10^{-5}$
		I	$3X10^{-7}$	$2X10^{-3}$	$1X10^{-8}$	$6X10^{-5}$
	Zn 69	S	$7X10^{-6}$	$5X10^{-2}$	$2X10^{-7}$	$2X10^{-3}$
		I	$9X10^{-6}$	$5X10^{-2}$	$3X10^{-7}$	$2X10^{-3}$
Zirconium (40)--------	Zr 93	S	$1X10^{-7}$	$2X10^{-2}$	$4X10^{-9}$	$8X10^{-4}$
		I	$3X10^{-7}$	$2X10^{-2}$	$1X10^{-8}$	$8X10^{-4}$
	Zr 95	S	$1X10^{-7}$	$2X10^{-3}$	$4X10^{-9}$	$6X10^{-5}$
		I	$3X10^{-8}$	$2X10^{-3}$	$1X10^{-9}$	$6X10^{-5}$
	Zr 97	S	$1X10^{-7}$	$5X10^{-4}$	$4X10^{-9}$	$2X10^{-5}$
		I	$9X10^{-8}$	$5X10^{-4}$	$3X10^{-9}$	$2X10^{-5}$
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than 2 hours.		Sub	$1X10^{-6}$	------	$3X10^{-8}$	------
Any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than 2 hours.			$3X10^{-9}$	$9X10^{-5}$	$1X10^{-10}$	$3X10^{-6}$
Any single radionuclide not listed above, which decays by alpha emission or spontaneous fission.			$6X10^{-13}$	$4X10^{-7}$	$2X10^{-14}$	$3X10^{-8}$

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[1] Soluble (S); Insoluble (I).

[2] "Sub" means that values given are for submersion in a semi-spherical infinite cloud of airborne material.

APPENDIX A

NOTE: In any case where there is a mixture in air or water of more than one radionuclide, the limiting values for purposes of this Appendix should be determined as follows:

1. If the identity and concentration of each radionuclide in the mixture are known, the limiting values should be derived as follows: Determine, for each radionuclide in the mixture, the ratio between the quantity present in the mixture and the limit otherwise established in Appendix "A" for the specific radionuclide when not in a mixture. The sum of such ratios for all the radionuclides in the mixture may not exceed "1" (i.e., "unity").

EXAMPLE: If radionuclides a, b, and c are present in concentrations C_a, C_b, and C_c, and if the applicable MPC's are MPC_a, MPC_b, and MPC_c, respectively, then the concentrations shall be limited so that the following relationship exists:

$$\frac{C_a}{MPC_a} + \frac{C_b}{MPC_b} + \frac{C_c}{MPC_c} \leq 1$$

2. If either the identity or the concentration of any radionuclide in the mixture is not known, the limiting values for purposes of Appendix "A" shall be:

a. For purposes of Table 1, Col. 1 --- $6X10^{-13}$

b. For purposes of Table 1, Col. 2 --- $4X10^{-7}$

c. For purposes of Table II, Col. 1 --- $2X10^{-14}$

d. For purposes of Table II, Col. 2 --- $3X10^{-8}$

3. If any of the conditions specified below are met, the corresponding values specified below may be used in lieu of those specified in paragraph 2 above.

a. If the identity of each radionuclide in the mixture is known but the concentration of one or more of the radionuclides in the mixture is not known, the concentration limit for the mixture is the limit specified in Appendix "A" for the radionuclide in the mixture having the lowest concentration limit; or,

b. If the identity of each radionuclide in the mixture is not known, but it is known that certain radionuclides specified in Appendix "A" are not present in the mixture, the concentration limit for the mixture is the lowest concentration limit specified in Appendix "A" for any radionuclide which is not known to be absent from the mixture; or,

c. Element (atomic number) and isotope	Table I		Table II	
	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
If it is known that Sr 90, I 125, I 126, I 129, I 131, (I 133, Table II only), Pb 210, Po 210, At 211, Ra 223, Ra 224, Ra 226, Ac 227, Ra 228, Th 230, Pa 231, Th 232, Th-nat, Cm 248, Cf 254, and Fm 256 are not present	------	9×10^{-5}	------	3×10^{-6}
If it is known that Sr 90, I 125, I 126, I 129, (I 131, I 133, Table II only), Pb 210, Po 210, Ra 223, Ra 226, Ra 228, Pa 231, Th-nat, Cm 248, Cf 254, and Fm 256 are not present	------	6×10^{-5}	------	2×10^{-6}
If it is known that Sr 90, I 129, (I 125, I 126, I 131, Table II only), Pb 210, Ra 226, Ra 228, Cm 248, and Cf 254 are not present	------	2×10^{-5}	------	6×10^{-7}
If it is known that (I 129, Table II only), Ra 226, and Ra 228 are not present	------	3×10^{-6}	------	1×10^{-7}
If it is known that alpha-emitters and Sr 90, I 129, Pb 210, Ac 227, Ra 228, Pa 230, Pu 241, and Bk 249 are not present	3×10^{-9}	------	1×10^{-10}	------
If it is known that alpha-emitters and Pb 210, Ac 227, Ra 228, and Pu 241 are not present	3×10^{-10}	------	1×10^{-11}	------
If it is known that alpha-emitters and Ac 227 are not present	3×10^{-11}	------	1×10^{-12}	------

APPENDIX A

	Table I		Table II	
Element (atomic number) and isotope	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)	Column 1 Air (uc/ml)	Column 2 Water (uc/ml)
If it is known that Ac 227, Th 230, Pa 231, Pu 238, Pu 239, Pu 240, Pu 242, Pu 244, Cm 248, Cf 249 and Cf 251 are not present-------	$3X10^{-12}$	------	$1X10^{-13}$	------

4. If the mixture of radionuclides consists of uranium and its daughter products in ore dust prior to chemical processing of the uranium ore, the values specified below may be used in lieu of those determined in accordance with paragraph 1 above or those specified in paragraphs 2 and 3 above.

a. For purposes of Table I, Column 1, 1×10^{-10} uc/ml gross alpha activity; or 2.5×10^{-11} uc/ml natural uranium; or 75 micrograms per cubic meter of air natural uranium.

b. For purposes of Table II, Column 1, 3×10^{-12} uc/ml gross alpha activity; or 8×10^{-13} uc/ml natural uranium; or 3 micrograms per cubic meter of air natural uranium.

5. For purposes of this note, a radionuclide may be considered as not present in a mixture if (a) the ratio of the concentration of that radionuclide in the mixture (C_a) to the concentration limit for that radionuclide specified in Table II of Appendix "A" (MPC_a) does not exceed 1/10, (i.e., $\frac{C_a}{MPC_a} \leq \frac{1}{10}$) and (b) the sum of such ratios for all radionuclides considered as not present in the mixture does not exceed 1/4, (i.e., $\frac{C_a}{MPC_a} + \frac{C_b}{MPC_b} + \ldots \leq \frac{1}{4}$).

PART C

APPENDIX B

Material	Micro-curies	Material	Micro-curies
Ag 105	1	Pd 103 + Rh 103	50
Ag 111	10	Pd 109	10
As 76, As 77	10	Pm 147	10
Au 198	10	Po 210	0.1
Au 199	10	Pr 143	10
Ba 140 + La 140	1	Pu 239	1
Be 7	50	Ra 226	0.1
C 14	50	Rb 86	10
Ca 45	10	Re 186	10
Cd 109 + Ag 109	10	Rh 105	10
Ce 144 + Pr 144	1	Ru 106 + Rh 106	1
Cl 36	1	S 35	50
Co 60	1	Sb 124	1
Cr 51	50	Sc 46	1
Cs 137 + Ba 137	1	Sm 153	10
Cu 64	50	Sn 113	10
Eu 154	1	Sr 89	1
F 18	50	Sr 90 + Y 90	0.1
Fe 55	50	Ta 182	10
Fe 59	1	Tc 96	1
Ga 72	10	Tc 99	1
Ge 71	50	Te 127	10
H 3 (HTO or H320)	250	Te 129	1
I 131	10	Th (natural)	50
In 114	1	Tl 204	50
Ir 192	10	Tritium. See H 3	250
K 42	10	U (natural)	50
La 140	10	U 233	1
Mn 52	1	U 234-U 235	50
Mn 56	50	V 48	1
Mo 99	10	W 185	10
Na 22	10	Y 90	1
Na 24	10	Y 91	1
Nb 95	10	Zn 65	10
Ni 59	1	Unidentified radioactive materials or any of the above in unknown mixtures	0.1
Ni 63	1		
P 32	10		

NOTE: For purposes of Sections 4.330 and 4.400 where there is involved a combination of isotopes in known amounts the limit for the combination should be derived as follows: Determine, for each isotope in the combination, the ratio between the quantity present in the combination and the limit otherwise established for the specific isotope when not in combination. The sum of such ratios for all the isotopes in the combination may not exceed "1" (i.e., "unity").

APPENDIX B

EXAMPLE: For purposes of Section 4.440 (1), if a particular batch contains 2,000 uc of Au^{198} and 25,000 uc of C^{14}, it may also include not more than 3,000 uc of I^{131}. This limit was determined as follows:

$$\frac{2{,}000\text{uc}}{10{,}000\text{uc}}\,Au^{198} + \frac{25{,}000\text{uc}}{50{,}000\text{uc}}\,C^{14} + \frac{3{,}000\text{uc}}{10{,}000\text{uc}}\,I^{131} = 1$$

The denominator in each of the above ratios was obtained by multiplying the figure in the table by 1,000 as provided in Section 4.440 (1).

Agency Form X
(Date)

[CITE APPROPRIATE AGENCY]

NOTICE TO EMPLOYEES

STANDARDS FOR PROTECTION AGAINST RADIATION

IN [CITE APPROPRIATE REGULATIONS], [CITE APPROPRIATE AGENCY] HAS ESTABLISHED STANDARDS FOR YOUR PROTECTION AGAINST RADIATION HAZARDS

YOUR EMPLOYER'S RESPONSIBILITY

Your employer is required to—

1. Apply these regulations to work involving sources of radiation.
2. Post or otherwise make available to you a copy of the [cite appropriate agency] regulations, licenses, and operating procedures which apply to work you are engaged in, and explain their provisions to you.

YOUR RESPONSIBILITY AS A WORKER

You should familiarize yourself with those provisions of the [cite appropriate agency] regulations, and the operating procedures which apply to the work you are engaged in. You should observe their provisions for your own protection and protection of your co-workers.

WHAT IS COVERED BY THESE REGULATIONS

1. Limits on exposure to radiation and radioactive material in restricted and unrestricted areas.
2. Measures to be taken after accidental exposure;
3. Personnel monitoring, surveys and equipment;
4. Caution signs, labels, and safety interlock equipment;
5. Exposure records and reports; and
6. Related matters.

REPORTS ON YOUR RADIATION EXPOSURE HISTORY

1. The [cite appropriate agency] regulations require that your employer give you a written report if you receive an exposure in excess of any applicable limit as set forth in the regulations or in the license. The basic limits for exposure to employees are set forth in Sections C.101, C.105, and C.104 of the regulations. These sections specify limits on exposure to radiation and exposure to concentrations of radioactive material in air and water.
2. If you work where personnel monitoring is required, and if you request information on your radiation exposures,
   - (a) Your employer must give you a written report, upon termination of your employment, of your radiation exposures, and
   - (b) Your employer must advise you annually of your exposure to radiation.

INSPECTIONS

All licensed or registered activities are subject to inspection by representatives of [cite appropriate agency].

INQUIRIES

Inquiries dealing with the matters outlined above can be sent to the [cite appropriate office] having inspection responsibility over your plant.

POSTING REQUIREMENT

COPIES OF THIS NOTICE MUST BE POSTED IN A SUFFICIENT NUMBER OF PLACES IN EVERY ESTABLISHMENT WHERE EMPLOYEES ARE EMPLOYED IN ACTIVITIES LICENSED OR REGISTERED, PURSUANT TO PART B, BY THE [CITE APPROPRIATE AGENCY], TO PERMIT EMPLOYEES WORKING IN OR FREQUENTING ANY PORTION OF A RESTRICTED AREA TO OBSERVE A COPY ON THE WAY TO OR FROM THEIR PLACE OF EMPLOYMENT.

Agency Form Y
(Date)

[CITE APPROPRIATE AGENCY]

OCCUPATIONAL EXTERNAL RADIATION EXPOSURE HISTORY

See Instructions on the Back

IDENTIFICATION

1. NAME (PRINT-Last, first, and middle)	2. SOCIAL SECURITY NO.
3. DATE OF BIRTH (Month, day, year)	4. AGE IN FULL YEARS (N)

OCCUPATIONAL EXPOSURE - PREVIOUS HISTORY

5. PREVIOUS EMPLOYMENTS INVOLVING RADIATION EXPOSURE (List Name and Address of employers)	6. DATES OF EMPLOYMENT (From - To)	7. PERIODS OF EXPOSURE	PREVIOUS DOSE HISTORY	
			8. WHOLE BODY (rem)	9. RECORD OR CALCULATED (Insert one)
10. REMARKS	11. ACCUMULATED OCCUPATIONAL DOSE TOTAL			

13. CALCULATIONS - PERMISSIBLE DOSE

WHOLE BODY:

(A) Permissible Accumulated Dose – 5(N–18) = ______ rem

(B) Total Exposure to Date (From Item 11) ______ rem

(C) Permissible Dose ______ rem

12. CERTIFICATION: I Certify that the Exposure History Listed In Columns 5, 6, and 7 is correct and complete to the best of my knowledge and belief.

______________________ ______
Employee's Signature Date

14. NAME OF LICENSEE OR REGISTRANT

INSTRUCTIONS FOR PREPARATION OF AGENCY FORM Y

This form or a clear and legible record containing all the information required on this form must be prepared by each licensee or registrant of the [Cite Appropriate Agency] who, pursuant to Section C.101, proposes to expose an individual to a radiation dose in excess of the amounts specified in Section C.101(a) of the regulations in Part C, "Standards for Protection Against Radiation." The requirement for completion of this form is contained in Section C.102 of that regulation. The information contained in this form is used for estimating the external accumulated occupational dose of the individual for whom the form is completed. A separate Agency Form Y shall be completed for each individual to be exposed to to a radiation dose in excess of the limits specified in Section C.101(a) of Part C of the [Cite Appropriate Agency] regulations.*

Listed below by item are instructions and additional information directly pertinent to completing this form:

IDENTIFICATION

Item 1. Self-explanatory.
Item 2. Self-explanatory except that, if individual has no social security number, the word "none" shall be inserted.
Item 3. Self-explanatory.
Item 4. Enter the age in full years. This is called "N" when used in calculating the Permissible Dose. N is equal to the number of years of age of the individual on his last birthday.

OCCUPATIONAL EXPOSURE

Item 5. List the name and address of each previous employer and the address of employment. Start with the most recent employer and work back. Include only those periods of employment since the eighteenth birthday involving occupational exposure to radiation. For periods of self-employment, insert the word "self-employed."
Item 6. Give the dates of employment.
Item 7. List periods during which occupational exposure to radiation occurred.
Item 8. List the dose recorded for each period of exposure from records of previous occupational exposure of the individual as calculated under Section C.102. Dose is to be given in rem.
"Dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of eye.
Item 9. After each entry in Item 8 indicate in Item 9 whether dose is obtained from records or calculated in accordance with Section C-102.
Item 10. Self-explanatory.

TOTAL ACCUMULATED OCCUPATIONAL DOSE (Whole Body)

Item 11. The total for the whole body is obtained by summation of all values in Item 8.

CERTIFICATION

Item 12. Upon completion of the report, the employee must certify that the information in Columns 5, 6, and 7 is accurate and complete to the best of his knowledge. The date is the date of his signature.

CALCULATIONS

Item 13. The lifetime accumulated occupational dose for each individual and the permissible dose under Section C.101(b) are obtained by carrying out the following steps: The value for N should be taken from Item 4. Subtract 18 from N and multiply the difference by 5 rem. (For example, John Smith, age 32; N = 32, PAD = 5(32–18) = 70 rem.) Enter total exposure to date from Item 11. Subtract (b) from (a) and enter the difference under (c). The value in (c) represents the unused part of the permissible accumulated dose. This value for permissible dose is to be carried forward to Agency Form Z, "Current Occupational External Radiation Exposure (Whole Body)."
Item 14. Self-explanatory.

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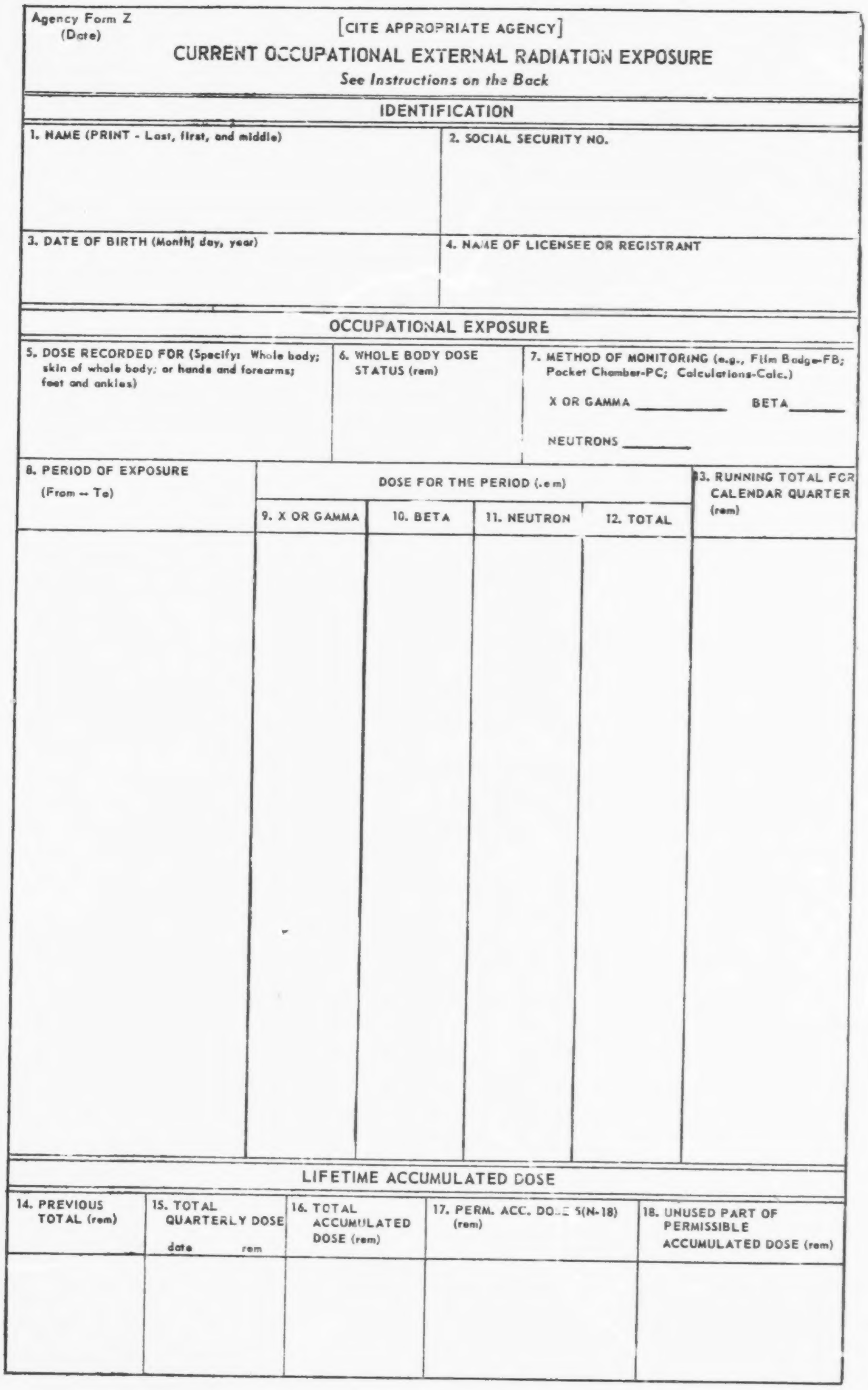
*This form requires the signature of the employee concerned.



Agency Form Z
(Date)

[CITE APPROPRIATE AGENCY]

CURRENT OCCUPATIONAL EXTERNAL RADIATION EXPOSURE

See Instructions on the Back

IDENTIFICATION

1. NAME (PRINT - Last, first, and middle)	2. SOCIAL SECURITY NO.
3. DATE OF BIRTH (Month, day, year)	4. NAME OF LICENSEE OR REGISTRANT

OCCUPATIONAL EXPOSURE

5. DOSE RECORDED FOR (Specify: Whole body; skin of whole body; or hands and forearms; feet and ankles)	6. WHOLE BODY DOSE STATUS (rem)	7. METHOD OF MONITORING (e.g., Film Badge-FB; Pocket Chamber-PC; Calculations-Calc.) X OR GAMMA ________ BETA ______ NEUTRONS ______

8. PERIOD OF EXPOSURE (From -- To)	DOSE FOR THE PERIOD (rem)				13. RUNNING TOTAL FOR CALENDAR QUARTER (rem)
	9. X OR GAMMA	10. BETA	11. NEUTRON	12. TOTAL	

LIFETIME ACCUMULATED DOSE

14. PREVIOUS TOTAL (rem)	15. TOTAL QUARTERLY DOSE date rem	16. TOTAL ACCUMULATED DOSE (rem)	17. PERM. ACC. DOSE 5(N-18) (rem)	18. UNUSED PART OF PERMISSIBLE ACCUMULATED DOSE (rem)

INSTRUCTION FOR PREPARATION OF AGENCY FORM Z

The preparation and safekeeping of this form or a clear and legible record containing all the information required on this form is required pursuant to Section C.401 of "Standards for Protection Against Radiation," as a current record of occupational external radiation exposures. Such a record must be maintained for each individual for whom personnel monitoring is required under Section C.202. Note that a separate Agency Form Z is to be used for recording external exposure to (1) the whole body; (2) skin of whole body; (3) hands and forearms; or (4) feet and ankles, as provided by Item 5 below.

Listed below by Item are instructions and additional information directly pertinent to completing this form.

IDENTIFICATION

Item 1. Self-explanatory.

Item 2. Self-explanatory except that, if individual has no social security number, the word "none" shall be inserted.

Item 3. Self-explanatory.

Item 4. Self-explanatory.

OCCUPATIONAL EXPOSURE

Item 5. "Dose to the whole body" shall be deemed to include any dose to the whole body, gonads, active blood-forming organs, head and trunk, or lens of eye. Unless the lenses of the eyes are protected with eye shields, dose recorded as whole body dose should include the dose delivered through a tissue equivalent absorber having a thickness of 300 mg/cm² or less. When the lenses of the eyes are protected with eye shields having a tissue equivalent thickness of at least 700 mg/cm², dose recorded as whole body dose should include the dose delivered through a tissue equivalent absorder having a thickness of 1,000 mg/cm² or less. Dose recorded as dose to the skin of the whole body, hands and forearms, or feet and ankles should include the dose delivered through a tissue equivalent absorber having a thickness of 7 mg/cm² or less. The dose to the skin of the whole body, hands and forearms, or feet and ankles should be recorded on separate forms unless the dose to those parts of the body has been included as dose to the whole body on a form maintained for recording whole body exposure.

Item 6. This item need be completed only when the sheet is used to record whole body exposures and the licensee or registrant is exposing the individual under the provisions of Section C.101(b) which allows up to 3 rems per quarter to the whole body. Enter in this item the unused part of permissible accumulated dose taken from previous records of exposure, i.e., Item 18 of the preceding Agency Form Z or Item 13 of Agency Form Y if the individual's exposure during employment with the licensee or registrant begins with this record.

Item 7. Indicate the method used for monitoring the individual's exposure to each type of radiation to which he is exposed in the course of his duties. Abbreviations may be used.

Item 8. Doses received over a period of less than a calendar quarter need not be separately entered on the form provided that the licensee or registrant maintains a current record of the doses received by the individual which have not as yet been entered on the form. The period of exposure should specify the day the measurement of that exposure was initiated and the day on which it was terminated. For example, if only quarterly doses are entered, the period of exposure for the first calendar quarter of 1962 might be taken as running from Monday, January 1, 1962, through Friday, March 30, 1962, and would be indicated in this item as Jan. 1, 1962-Mar. 30, 1962. If weekly doses are entered, a film badge issued Monday morning, January 1, 1962, and picked up Friday, January 5, 1962, would be indicated as Jan. 1. 1962-Jan. 5, 1962.

Item 9. 10 and 11. Self-explanatory. The values are to be given in rem. All measurements are to be interpreted in the best method known and in accordance with Section A.3(c). Where calculations are made to determine dose, a copy of such calculations is to be maintained in conjunction with this record. In any case where the dose for a calendar quarter is less than 10% of the value specified in Section C.101(a), the phrase "less than 10%" may be entered in lieu of a numerical value.

Item 12. Add the values under Item 9, 10 and 11 for each period of exposure and record the total. In calculating the "Total" any entry "less than 10%" may be disregarded.

Item 13. The running total is to be maintained on the basis of calendar quarters. Section A.2(a)(6) defines calendar quarter. No entry need be made in this item if only calendar quarter radiation doses are recorded in Items 9, 10, 11, and 12.

LIFETIME ACCUMULATED DOSE (Whole Body)

Note: If the licensee or registrant chooses to keep the individual's exposure below that permitted in Section C.101(a), Items 14 through 18 need not be completed. However, in that case the total whole body dose for each calendar quarter recorded in Item 13 (or in Item 12 if quarterly doses are entered in Item 12) should not exceed 1¼ rem.

If an individual is exposed under the provisions of Section. C.101(b), complete Items 14 through 18 at the end of each calendar quarter and when the sheet is filled. Values in Item 13, when in the middle of a calendar quarter, and values in Item 18, must be brought forward to next sheet for each individual.

Item 14. Enter the previous *total* accumulated dose from previous dose records for the individual (e.g., from Item 16 of Agency Form Z or Item 11 of Agency Form Y). The total occupational radiation dose received by the individual must be entered in this item, including any occupational dose received from sources of radiation not licensed or registered by the Agency. If the individual was exposed to sources of radiation not licensed or registered by the Agency during any calendar quarter after completing Agency Form Y and personnel monitoring equipment was not worn by the individual, it should be assumed that the individual received a dose of 1¼ rems during each such calendar quarter.

Item 15. Enter the total calendar quarter dose from Item 13 (or from Item 12 if quarterly doses are entered in Item 12) and the date designating the end of the calendar quarter in which the dose was received (e.g., March 30, 1962).

Item 16. Add Item 14 and Item 15 and enter that sum.

Item 17. Obtain the Permissible Accumulated Dose (PAD) in rem for the WHOLE BODY. "N" is equal to the number of years of age of the individual on his last birthday. Subtract 18 from N and multiply the difference by 5 rem (e.g., John Smith, age 32; N = 32; PAD = 5 (32–18) = 70 rem).

Item 18. Determine the unused part of the PAD by subtracting Item 16 from Item 17. The unused part of the PAD is that portion of the Lifetime Accumulated Dose for the individual remaining at the end of the period covered by this sheet.

PART D*

RADIATION SAFETY REQUIREMENTS FOR INDUSTRIAL RADIOGRAPHIC OPERATIONS

Sec. D.1 Purpose. The regulations in this part establish radiation safety requirements for persons utilizing sources of radiation for industrial radiography. The requirements of this part are in addition to and not in substitution for the other requirements of these regulations.

Sec. D.2 Scope. The regulations in this part apply to all licensees or registrants who use sources of radiation for industrial radiography; provided, however, that nothing in this part shall apply to uses of sources of radiation in the healing arts.

DEFINITIONS

Sec. D.3 Definitions. As used in this part:

(a) "Radiographer" means any individual who performs or who, in attendance at the site where sources of radiation are being used, personally supervises industrial radiographic operations and who is responsible to the licensee or registrant for assuring compliance with the requirements of these regulations and all license conditions.

(b) "Radiographer's assistant" means any individual who, under the personal supervision of a radiographer, uses sources of radiation, related handling tools, or survey instruments in industrial radiography.

(c) "Radiographic exposure device" means any instrument containing a sealed source fastened or contained therein, in which the sealed source or shielding thereof may be moved, or otherwise changed, from a shielded to unshielded position for purposes of making a radiographic exposure.

(d) "Industrial radiography" means the examination of the macroscopic structure of materials by nondestructive methods utilizing sources of radiation.

(e) "Storage container" means a device in which sealed sources are transported or stored.

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* NOTE: Requirements of this Part D which refer to "radiographic exposure devices" or "sealed sources" apply to the use of radioactive material. Requirements which refer to "sources of radiation" apply to the use of radiation machines and radioactive material.

(f) "Cabinet radiography using radiation machines" means industrial radiography which is conducted in an enclosed, interlocked cabinet, such that the radiation machine will not operate unless all openings are securely closed, and which cabinet is so shielded that every location on the exterior meets conditions for an unrestricted area as specified in Section C.105.

(g) "Shielded room radiography using radiation machines" means industrial radiography using radiation machines, which is conducted in an enclosed room, the interior of which is not occupied during radiographic operations, which is so shielded that every location on the exterior meets conditions for an unrestricted area as specified in Section C.105, and the only access to which is through openings which are interlocked so that the radiation machine will not operate unless all openings are securely closed.

EQUIPMENT CONTROL

Sec. D.101 Limits on Levels of Radiation for Radiographic Exposure Devices and Storage Containers. Radiographic exposure devices measuring less than four (4) inches from the sealed source storage position to any exterior surface of the device shall have no radiation level in excess of 50 milliroentgens per hour at six (6) inches from any exterior surface of the device. Radiographic exposure devices measuring a minimum of four (4) inches from the sealed source storage position to any exterior surface of the device, and all storage containers for sealed sources or outer containers for radiographic exposure devices, shall have no radiation level in excess of 200 milliroentgens per hour at any exterior surface, and ten (10) milliroentgens per hour at one meter from any exterior surface. The radiation levels specified are with the sealed source in the shielded (i.e., "off") position.

Sec. D.102 Locking of Sources of Radiation. Each source of radiation shall be provided with a lock or outer-locked container designed to prevent unauthorized or accidental production of radiation or removal or exposure of a sealed source and shall be kept locked at all times except when under the direct surveillance of a radiographer or radiographer's assistant, or as may be otherwise authorized pursuant to Section D.301. Each storage container likewise shall be provided with a lock and kept locked when containing sealed sources except when the container is under the direct surveillance of a radiographer or radiographer's assistant.

Sec. D.103 Storage Precautions. Locked radiographic exposure devices and storage containers shall be physically secured to prevent tampering or removal by unauthorized personnel.

Sec. D.104 Radiation Survey Instruments. The licensee or registrant shall maintain sufficient calibrated and operable radiation survey instruments to make physical radiation surveys as required by this part and Part C of these regulations. Each radiation survey instrument shall be calibrated at intervals not to exceed three (3) months and after each instrument servicing and a record maintained of the latest date of calibration. Instrumentation required by this section shall have a range such that two milliroentgens per hour through one roentgen per hour can be measured.

Sec. D.105 Leak Testing, Repair, Tagging, Opening, Modification, and Replacement of Sealed Sources.

(a) The replacement of any sealed source fastened to or contained in a radiographic exposure device and leak testing, repair, tagging, opening, or any other modification of any sealed source shall be performed only by persons specifically authorized to do so by the Agency, the U.S. Atomic Energy Commission, or any agreement state.

(b) Each sealed source shall be tested for leakage at intervals not to exceed 6 months. In the absence of a certificate from a transferor that a test has been made within the 6-month period prior to the transfer, the sealed source shall not be put into use until tested.

(c) The leak test shall be capable of detecting the presence of 0.005 microcurie of removable contamination on the sealed source. An acceptable leak test for sealed sources in the possession of a radiography licensee would be to test at the nearest accessible point to the sealed source storage position, or other appropriate measuring point, by a procedure to be approved pursuant to Section B.26(f)(5) of Part B. Records of leak test results shall be kept in units of microcuries and maintained for inspection by the Agency.

(d) Any test conducted pursuant to paragraphs (b) and (c) of this section which reveals the presence of 0.005 microcurie or more of removable radioactive material shall be considered evidence that the sealed source is leaking. The licensee shall immediately withdraw the equipment involved from use and shall cause it to be decontaminated and repaired or to be disposed of, in accordance with regulations of the Agency. Within 5 days after obtaining results of the test, the licensee shall file a report with the Agency describing the equipment involved, the test results, and the corrective action taken.

(e) A sealed source which is not fastened to or contained in a radiographic exposure device shall have permanently attached to it a durable tag at least one (1) inch square bearing the prescribed radiation caution symbol in conventional colors, magenta or purple on a yellow background, and at least the instructions: "Danger - Radioactive Material - Do Not Handle - Notify Civil Authorities if Found."

Sec. D.106 Quarterly Inventory. Each licensee or registrant shall conduct a quarterly physical inventory to account for all sources of radiation received or possessed by him. The records of the inventories shall be maintained for inspection by the Agency and shall include the quantities and kinds of radioactive material, the location of all sources of radiation, and the date of the inventory.

Sec. D.107 Utilization Logs. Each licensee or registrant shall maintain current logs, which shall be kept available for inspection by the Agency, showing for each source of radiation the following information:

(a) A description (or make and model number) of each source of radiation or storage container in which the sealed source is located;

(b) The identity of the radiographer to whom assigned; and,

(c) Locations where used and dates of use.

PERSONAL RADIATION SAFETY REQUIREMENTS FOR RADIOGRAPHERS AND RADIOGRAPHERS' ASSISTANTS

Sec. D.201 Limitations.

(a) No licensee or registrant shall permit any person to act as a radiographer as defined in this part until such person:
  (1) Has been instructed in the subjects outlined in Appendix A of this part and shall have demonstrated understanding thereof;
  (2) Has received copies of and instruction in the regulations contained in this part and the applicable sections of Part C, Agency license(s), and the licensee's or registrant's operating and emergency procedures, and shall have demonstrated understanding thereof; and,
  (3) Has demonstrated competence to use the source of radiation, related handling tools, and survey instruments which will be employed in his assignment.

(b) No licensee or registrant shall permit any person to act as a radiographer's assistant as defined in this part until such person:
  (1) Has received copies of and instructions in the licensee's or registrant's operating and emergency procedures, and shall have demonstrated understanding thereof; and,
  (2) Has demonstrated competence to use under the personal supervision of the radiographer the sources of radiation, related handling tools, and radiation survey instruments which will be employed in his assignment.

Sec. D.202 Operating and Emergency Procedures. The licensee's or registrant's operating and emergency procedures shall include instructions in at least the following:

(a) The handling and use of sources of radiation to be employed such that no person is likely to be exposed to radiation doses in excess of the limits established in Part C, "Standards For Protection Against Radiation";

(b) Methods and occasions for conducting radiation surveys;

(c) Methods for controlling access to radiographic areas;

(d) Methods and occasions for locking and securing sources of radiation;

(e) Personnel monitoring and the use of personnel monitoring equipment;

(f) Transportation to field locations, including packing of sources of radiation in the vehicles, posting of vehicles, and control of sources of radiation during transportation;

(g) Minimizing exposure of persons in the event of an accident;

(h) The procedure for notifying proper persons in the event of an accident; and,

(i) Maintenance of records.

Sec. D.203 Personnel Monitoring Control.

(a) No licensee or registrant shall permit any person to act as a radiographer or as a radiographer's assistant unless, at all times during radiographic operations, each such person shall wear a film badge and either a pocket dosimeter or pocket chamber. Pocket dosimeters and pocket chambers shall be capable of measuring doses from zero to at least 200 milliroentgens. A film badge shall be assigned to and worn by only one person.

(b) Pocket dosimeters and pocket chambers shall be read and doses recorded daily. A film badge shall be immediately processed if a pocket chamber or pocket dosimeter is discharged beyond its range. The film badge reports received from the film badge processor and records of pocket dosimeter and pocket chamber readings shall be maintained for inspection by the Agency.

PRECAUTIONARY PROCEDURES IN RADIOGRAPHIC OPERATIONS

Sec. D.301 Security. During each radiographic operation, the radiographer or radiographer's assistant shall maintain a direct surveillance of the operation to protect against unauthorized entry into a high radiation area, as defined in Part C, except (a) where the high radiation area is equipped with a control device or an alarm system as described in Section C.203(c)(2), or (b) where the high radiation area is locked to protect against unauthorized or accidental entry.

Sec. D.302 Posting. Notwithstanding any provisions in Section C.204(c), areas in which radiography is being performed shall be conspicuously posted as required by Section C.203(b) and (c)(1).

Sec. D.303 Radiation Surveys and Survey Records.

(a) No radiographic operation shall be conducted unless calibrated and operable radiation survey instrumentation as described in Section D.104 is available and used at each site where radiographic exposures are made.

(b) A physical radiation survey shall be made after each radiographic exposure utilizing radiographic exposure devices or sealed sources of radioactive material to determine that the sealed source has been returned to its shielded condition.

(c) A physical radiation survey shall be made to determine that each sealed source is in its shielded condition prior to securing the radiographic exposure device or storage container as specified in Section D.102.

(d) Records shall be kept of the surveys required by paragraph (c) of this section and maintained for inspection by the Agency.

Sec. D.304 Special Requirements for Radiography Employing Radiation Machines.

(a) Cabinet Radiography. Cabinet radiography using radiation machines shall be exempt from other requirements of this Part D; however, no registrant shall permit any individual to operate a cabinet radiography unit until such individual has received a copy of, and instruction in, and demonstrated an understanding of operating procedures for the unit, and has demonstrated competence in its use.

(b) Shielded Room Radiography. Shielded room radiography using radiation machines shall be exempt from other requirements of this Part D; however,

(1) No registrant shall permit any individual to operate a radiation machine for shielded room radiography until such individual has received a copy of, and instruction in, and demonstrated an understanding of operating procedures for the unit, and has demonstrated competence in its use.

(2) Each registrant shall supply appropriate personnel monitoring equipment to, and shall require the use of such equipment by, every individual who operates, who makes "set-ups", or who performs maintenance on a radiation machine for shielded room radiography.

(3) A physical radiation survey shall be conducted to determine that the radiation machine is "off" prior to each entry into the shielded room. Such surveys shall be made with a radiation measuring instrument capable of measuring radiation of the energies and at the exposure rates to be encountered, which is in good working order, and which has been properly calibrated within the preceding three months or following the last instrument servicing, whichever is later.

(c) Other radiography using radiation machines shall be exempt from Sections D.101, D.103, D.105, and D.303 of this part; however,

(1) A physical radiation survey shall be conducted to determine that the radiation machine is "off" prior to each entry into the radiographic exposure area. Such surveys shall be made with a radiation measuring instrument capable of measuring radiation of the energies and at the dose rates to be encountered, which is in good working order, and which has been properly calibrated within the preceding three months or following the last instrument servicing, whichever is later. Survey results and records of boundary locations shall be maintained and kept available for inspection.

(2) Mobile or portable radiation machines shall be physically secured to prevent removal by unauthorized personnel.

Part D

APPENDIX A

INSTRUCTION OF RADIOGRAPHERS

I. Fundamentals of Radiation Safety
   - A. Characteristics of gamma and X-radiation
   - B. Units of radiation dose (mrem) and quantity of radioactivity (curie)
   - C. Hazards of excessive exposure of radiation
   - D. Levels of radiation from sources of radiation
   - E. Methods of controlling radiation dose
      - 1. Working time
      - 2. Working distances
      - 3. Shielding

II. Radiation Detection Instrumentation to be Used
   - A. Use of radiation survey instruments
      - 1. Operation
      - 2. Calibration
      - 3. Limitations
   - B. Survey techniques
   - C. Use of personnel monitoring equipment
      - 1. Film badges
      - 2. Pocket dosimeters
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III. Radiographic Equipment to be Used
   - A. Remote handling equipment
   - B. Radiographic exposure devices and sealed sources
   - C. Storage containers
   - D. Operation and control of X-ray equipment

IV. The Requirements of Pertinent Federal and State Regulations

V. The Licensee's or Registrant's Written Operating and Emergency Procedures

PART E

USE OF X-RAYS IN THE HEALING ARTS

Sec. E.1. Scope. This part establishes requirements for use of X-ray producing devices in the healing arts by a practitioner licensed by law to use or direct the use of such devices in the course of his professional practice or upon a prescription or other order lawfully issued in the course of his professional practice. The provisions of this part are in addition to, and not in substitution for, other applicable provisions of these regulations.

Sec. E.2. Definitions.

(a) Aluminum equivalent - The thickness of aluminum affording the same attenuation, under specified conditions, as the material in question.

(b) Barrier - See Protective Barrier

(c) Collimator - A device or mechanism by which the X-ray beam is restricted in size.

(d) Dead-man Switch - A switch so constructed that a circuit-closing contact can be maintained only by continuous pressure on the switch by the operator.

(e) Diagnostic-type tube housing - An X-ray tube housing so constructed that the leakage radiation measured at a distance of 1 meter from the source cannot exceed 100 mr in 1 hour when the tube is operated at its maximum continuous rated current for the maximum rated tube potential.

(f) Diaphragm - A device or mechanism by which the X-ray beam is restricted in size.

(g) Half-value layer (hvl) - The thickness of a specified substance which when introduced into the path of a given beam or radiation reduces the exposure rate by one half.

(h) Inherent filtration - The filtration permanently in the useful beam; it includes the window of the X-ray tube and any permanent tube or source enclosure.

(i) Interlock - A device for precluding access to an area of high radiation by automatically reducing the exposure rate.

(j) Kilovolts peak (kVp) - The value in kilovolts of the potential of a pulsating potential generator. When only one-half of the wave is used, the value refers to the useful half of the wave.

(k) Lead equivalent - The thickness of lead affording the same attenuation, under specified conditions, as the material in question.

(l) Leakage radiation - All radiation coming from within the tube housing except the useful beam.

(m) Primary barrier - A barrier sufficient to attenuate the useful beam to the required degree.

(n) Protective Apron - Apron made of radiation absorbing materials, used to reduce radiation exposure.

(o) Protective Barrier - A barrier of radiation absorbing material(s) used to reduce radiation exposure.

(p) Protective Gloves - Glove made of radiation absorbing materials used to reduce radiation exposure.

(q) Qualified expert - An individual who has demonstrated to the satisfaction of the Agency that he possesses the knowledge and training to measure ionizing radiation, to evaluate safety techniques, and to advise regarding radiation protection needs.

(r) Scattered radiation - Radiation that, during passage through matter, has been deviated in direction.

(s) Secondary barrier - A barrier sufficient to attenuate stray radiation to the required degree.

(t) Shutter - An adjustable device, generally of lead, fixed to an X-ray tube housing to collimate the useful beam.

(u) Therapeutic-type-protective tube housing - 1) For X-ray therapy equipment not capable of operating at 500 kVp or above the following definition applies: An X-ray tube housing so constructed that the leakage radiation at a distance of one meter from the source does not exceed one roentgen in an hour when the tube is operated at its maximum rated continuous current for the maximum rated tube potential. 2) For X-ray therapy equipment capable of operation at 500 kVp or above the following definition applies: An X-ray tube housing so constructed that leakage radiation at a distance of one meter from the source does not exceed an exposure of one roentgen in an hour or 0.1 percent of the useful beam dose rate at one meter from the source, whichever is greater, when the machine is operated at its maximum rated continuous current for the maximum rated accelerating potential.

Sec. E.3 General Safety Provisions.

(a) No person shall make, sell, lease, transfer, lend or install X-ray equipment or the supplies used in connection with such equipment unless such supplies and equipment, when placed in operation and used, will meet the requirements of these regulations.

(b) Use.
  (1) The registrant shall assure that all X-ray equipment under his control is operated only by individuals adequately instructed in safe operating procedures and competent in safe use of the equipment.
  (2) The registrant shall provide safety rules to each individual operating X-ray equipment under his control, including any restrictions of the operating technique required for the safe operation of the particular X-ray apparatus, and require that the operator demonstrate familiarity with these rules.

(c) Shielding. Each installation shall be provided with such primary barriers and/or secondary barriers as are necessary to assure compliance with Sections D.101, D.104, and D.105.

(d) Prohibited Use. No registrant shall operate or permit the operation of X-ray equipment unless the equipment and installation meet the applicable requirements of these regulations.

Sec. E.4 Fluoroscopic Installations.

(a) Equipment.
  (1) The tube housing shall be of diagnostic type.
  (2) The target-to-panel or target-to-table top distance of equipment installed after the effective date of this part shall not be less than twelve (12) inches.

(3) The total filtration permanently in the useful beam, including the aluminum equivalent of table top or panel top, shall not be less than 2.5 millimeters aluminum. This requirement may be assumed to have been met if the half-value layer is equivalent to not less than 2.5 millimeters of aluminum at normal operating voltages.

(4) The equipment shall be so constructed that the entire cross-section of the useful beam is attenuated by a primary barrier. (Usually the viewing device on conventional fluoroscopic units or an image intensification mechanism).

  (i) For equipment installed after effective date of this part the required lead equivalent of the barrier shall not be less than (1) 1.5 millimeters for up to 100 kVp, (2) shall not be less than 1.8 millimeters for 100-125 kVp, (3) shall not be less than 2.0 millimeters for 126-150 kVp.

  (ii) Collimators shall be provided to restrict the size of the useful beam to less than the area of the barrier. For conventional fluoroscopes this requirement is met if, when the adjustable diaphragm is opened to its fullest extent, an unilluminated margin is left on the fluorescent screen with the screen centered in the beam at a distance of thirty-five (35) centimeters (fourteen (14) inches) from the panel or table top The margin requirement does not apply to installations where image intensification is used, but a shutter shall be provided in these installations so that the useful beam is restricted to the diameter of the input phosphor.

  (iii) The tube mounting and the viewing device shall be so linked together that, under conditions of normal use, the barrier always intercepts the entire useful beam.

  (iv) Collimators and adjustable diaphragms or shutters to restrict the size of the useful beam shall provide the same degree of protection as is required of the housing.

(5) The exposure switch shall be of the dead-man type.

(6) A manual-reset, cumulative timing device shall be used which will either indicate elapsed exposure time by an audible signal or turn off the apparatus when the total exposure exceeds a pre-determined limit not exceeding 5 minutes in one or a series of exposures.

(7) A shielding device of at least 0.25 millimeter lead equivalent shall be provided for covering the Bucky slot during fluoroscopy.

(8) Protective drapes or hinged sliding panels shall be provided between the patient and fluoroscopist to intercept scattered radiation which would otherwise reach the fluoroscopist and others near the machine. Such devices shall not substitute for wearing of a protective apron.

(9) Protective aprons of at least 0.25 millimeters lead equivalent shall be worn in the fluoroscopy room by each person whose body is likely to be exposed to 5 mR/hr. or more.

(10) For routine fluoroscopy, the exposure rate measured at the panel or table top shall not exceed ten (10) Roentgens per minute.

(11) Mobile fluoroscopic equipment is subject to the following additional requirements:
  (i) In the absence of a table top, a cone or spacer frame shall limit the target-to-skin distance to not less than twelve (12) inches.
  (ii) Image intensification shall always be provided.
  (iii) It shall be impossible to operate a machine unless the useful beam is intercepted by the image intensifier.
  (iv) The exposure rate measured at the minimum target-to-skin distance shall not exceed ten (10) Roentgens per minute.

Sec. E.5 Radiographic Installation Other Than Dental and Veterinary Medicine.

(a) Equipment.
  (1) The tube housing shall be of diagnostic type.
  (2) Diaphragms, cones, or adjustable collimators capable of restricting the useful beam to the area of clinical interest shall be provided and shall provide the same degree of protection as is required of the housing. When used with photofluorographic equipment these devices shall restrict the useful beam to the area of the photofluorographic screen.
  (3) (i) The aluminum equivalent of the total filtration in the primary beam shall be not less than that shown in the following table except when contraindicated for a particular diagnostic procedure:

Operating Voltage (kVp)	Total Filtration -- Inherent plus added (millimeters aluminum equivalent)
Below 50	0.5 millimeters
50 - 70	1.5 millimeters
Above 70	2.5 millimeters

(ii) If the filter in the machine is not accessible for examination or the total filtration is unknown, it can be assumed that the requirements of F.5 (a)(3)(i) are met if the half-value layer is not less than that shown in the following table:

Operating Voltage (kVp)	Half-Value layer (millimeters aluminum)
50	0.6
70	1.6
90	2.6
100	2.8
110	3.0
120	3.3

(4) A device shall be provided to terminate the exposure after a preset time or exposure.

(5) The exposure switch shall be of the dead-man type.

(6) (i) The control panel shall include a device (usually a milliammeter) which will give positive indication of the production of X-rays whenever the X-ray tube is energized.

(ii) The control panel shall include appropriate indicators (labelled control settings and/or meters) indicating the physical factors (such as kVp, mA, exposure time or whether timing is automatic) used for the exposure.

(b) Structural Shielding.

(1) All wall, floor, and ceiling areas struck by the useful beam shall have primary barriers. Primary barriers in walls shall extend to a minimum height of eighty-four (84) inches above the floor.

(2) Secondary barriers shall be provided in all wall, floor, and ceiling areas not having primary barriers.

(3) The operator's station at the control shall be behind a protective barrier. It shall be impossible for the operator to energize the tube while outside the protective barrier. "Spot film" devices used in conjunction with fluoroscopic tables are exempted from this requirement.

(4) A window of lead equivalent glass equal to that required by the adjacent barrier, or a mirror system, shall be provided and it shall be large enough and so placed that the operator can see the patient during the exposure without having to leave the protected area.

(c) Operating Procedures.

(1) When a patient must be held in position for radiography, mechanical supporting or restraining devices should be used. If the patient must be held by an individual, that individual shall be protected with appropriate shielding devices such as protective gloves and apron and he shall be so positioned that no part of his body, except hands and arms, will be struck by the useful beam.

(2) Only individuals required for the radiographic procedure shall be in the radiographic room during exposure; and, except for the patient, all such persons shall be equipped with appropriate protective devices.

(3) The useful beam shall be restricted to the area of clinical interest.

(4) Personnel monitoring shall be required for all individuals operating photofluorographic equipment.

Sec. E.6 Special Requirements for Mobile Diagnostic Radiographic Equipment.

(a) Equipment.

(1) All requirements of Paragraph F.5 (a) apply.

(2) The exposure control switch shall be of the dead-man type and shall be so arranged that the operator can stand at least six (6) feet from the patient and well away from the useful beam.

(b) Structural Shielding. When a mobile unit is used routinely in one location, it shall be considered a fixed installation subject to the shielding requirements specified in F.3 (c) and F.5 (b).

(c) Operating Procedures.

(1) All provisions of Paragraph F.5 (c) apply except F.5 (c)(2).

(2) Personnel monitoring shall be required for all individuals operating mobile X-ray equipment.

Sec. E.7 Dental Radiographic Installations.

(a) Equipment.

(1) The tube housing shall be of diagnostic type.

(2) Diaphragms or cones shall be used for restricting the useful beam and shall provide the same degree of protection as the housing. The diameter of the useful beam at the end of the cone shall not be more than three (3) inches for intra-oral radiography.

(3) A cone or spacer frame shall provide a target-to-skin distance of not less than seven (7) inches with apparatus operating above fifty (50) kVp or four (4) inches with apparatus operating at fifty (50) kVp or below.

(4) (i) The aluminum equivalent of the total filtration in the useful beam shall not be less than that shown in the following table:

Operating Voltage (kVp)	Total Filtration - Inherent plus added (millimeters aluminum equivalent)
70 and below	1.5
Above 70	2.5

(ii) If the filter in the machine is not accessible for examination or the total filtration is unknown, it can be assumed that the requirements of F.7 (a)(4)(i) are met if the half-value layer is not less than that shown in the following table:

Operating Voltage (kVp)	Half-Value Layer (millimeters aluminum)
70 and below	1.5
Above 70	2.5

(5) A device shall be provided to terminate the exposure after a preset time or exposure. The exposure switch shall be of the dead-man type.

(6) Each installation shall be provided with a protective barrier for the operator or shall be so arranged that the operator can stand at least six (6) feet from the patient and well away from the useful beam.

(7) All machines installed after the effective date of these regulations shall be equipped with open end cones (cylinder).

(b) Structural Shielding.

(1) Dental rooms containing X-ray machines shall be provided with such primary barriers and/or secondary barriers as are necessary to assure compliance with sections D.101, D.104, and D.105.

NOTE: In many cases structural materials of ordinary walls suffice as a protective barrier without addition of special shielding material.

(c) Operating Procedures.

(1) Neither the dentist nor his assistant shall hold patients or films during exposure, nor shall any individual be regulatly used for this service.
(2) During each exposure, the operator shall stand at least six (6) feet from the patient or behind a protective barrier.
(3) Only the patient shall be in the useful beam.
(4) Neither the tube housing nor the cone shall be hand-held during the exposure.
(5) Fluoroscopy shall not be used in dental examinations.

Sec. E.8 Therapeutic X-ray Installations.

(a) Equipment.

(1) The tube housing shall be of therapeutic type.
(2) Permanent diaphragms or cones used for collimating the useful beam shall afford the same degree of protection as the tube housing. Adjustable or removal beam-defining diaphragms or cones shall transmit not more than five (5) percent of the useful beam at the maximum kilovoltage and with maximum treatment filter.
(3) Filters shall be secured in place to prevent them from dropping out during treatment. The filter slot shall be so constructed that the radiation escaping through it does not exceed one (1) Roentgen per hour at one (1) meter, or, if the radiation from the slot is accessible to the patient, thirty (30) Roentgens per hour at five (5) centimeters from the external opening. Each removable filter shall be marked with its thickness and material.
(4) A filter indication system shall be used on all therapy machines using changeable filters. It shall be designed so as to permit easy recognition of any added filter in place.

(5) The X-ray tube shall be so mounted that it cannot turn or slide with respect to the aperture.

(6) Means shall be provided to immobilize the tube housing during stationary portal treatment.

(7) A device (e.g., an automatic timer, exposure meter or dose meter) shall be provided to terminate the exposure after a preset time interval or preset exposure or dose limit.

(8) Equipment utilizing shutters to control the useful beam shall have a shutter position indicator on the control panel.

(9) The control panel shall include a device (usually a milliammeter) which will give positive indication of the production of X-rays whenever the X-ray tube is energized.

(b) Structural Shielding.

(1) All walls, floors, and ceilings that can be struck by the useful beam shall be provided with primary barriers.

(2) All walls, floors, and ceilings that, because of restrictions in the orientation of the useful beam, cannot be struck by the useful beam shall be provided with secondary barriers.

(3) With equipment operating above one hundred and twenty-five (125) kVp, the required barriers shall be an integral part of the building.

(4) With equipment operating above one hundred and fifty (150) kVp, the control panel shall be within a protective booth equipped with an interlocked door, or outside the treatment room.

(5) Interlocks shall be provided for X-ray therapy equipment capable of operating above 150 kVp so that when any door of the treatment room is opened either the machine will shut-off automatically or the radiation level within the room will be reduced to an average of not more than two milliroentgens per hour and a maximum of ten milliroentgens per hour at a distance of one (1) meter in any direction from the target. After such shut-off or reduction in output it shall be possible to restore the machine to full operation only from the control panel.

(6) Provision shall be made to permit continuous observation of patient during irradiation.

(7) Windows, mirror systems, or closed-circuit television viewing screens used for observing the patient shall be so located that the operator may see the patient and the control panel from the same position.

(c) Operating Procedures.
  (1) All new facilities and existing facilities not previously surveyed, shall have a protection survey made by, or under the direction of, a qualified expert. This shall also be done after any change in the facility which might produce a radiation hazard. The expert shall report his findings in writing to the person in charge of the facility and a copy of this report shall be transmitted to the agency.
  (2) The facility shall be operated in compliance with any limitations indicated by the protection survey.
  (3) When a patient must be held in position for radiation therapy, mechanical supporting or restraining devices shall be used whenever feasible. If the patient must be held by an individual, that individual shall be adequately protected and he shall be positioned so that no part of his body except hands and arms will be struck by the useful beam and that his body is as far as possible from the edge of the useful beam. The exposure of any individual used for this purpose shall be monitored.
  (4) The output of each therapeutic X-ray machine shall be calibrated by or under the direction of a qualified expert. The calibration shall be repeated after any change in or replacement of components of the X-ray generating equipment which could cause a change in X-ray output. Check calibrations shall be made at least once a year thereafter. Records of calibration shall be maintained by the registrant.

Sec. E.9 Special Requirements for X-ray Therapy Equipment Operated at Potentials of Sixty (60) kVp and Below.

(a) Equipment.
  (1) All provisions of Section F.8 (a) apply except the leakage radiation 5 cm. from the surface of the tube housing shall not exceed 0.1 Roentgen per hour.
  (2) The control panel shall include a device (usually a milliammeter) which will give positive indication of the production of X-rays whenever the X-ray tube is energized.

(b) Operating Procedures.
  (1) Automatic timers shall be provided which will permit accurate presetting and termination of exposures as short as one second.
  (2) In the therapeutic application of apparatus constructed with beryllium or other low-filtration windows, the registrant shall insure that the unfiltered radiation reaches only the part intended and that the useful beam is blocked at all times except when actually being used.

(3) Machines having an output of more than 1,000 Roentgens per minute at any accessible place shall not be left unattended without the power being shut-off at the primary disconnecting means.

(4) If the tube is hand-held during irradiation, the operator shall wear protective gloves and protective apron.

Sec. E.10 Veterinary Medicine Radiographic Installations.

(a) Equipment.

(1) The tube housing shall be of diagnostic type.

(2) Diaphragms or cones shall be provided for collimating the useful beam to the area of clinical interest and shall provide the same degree of protection as is required of the housing.

(3) Except when contraindicated for a particular radiographic purpose, the total filtration permanently in the useful beam shall not be less than 1.5 millimeters aluminum equivalent for machines operating up to seventy (70) kVp and 2.0 millimeters aluminum equivalent for machines operated at seventy (70) kVp or above.

(4) A device shall be provided to terminate the exposure after a preset time or exposure.

(5) A dead-man type of exposure switch shall be provided, together with an electrical cord of sufficient length so that the operator can stand out of the useful beam and at least six (6) feet from the animal during all X-ray exposures.

(b) Structural Shielding.

(1) All wall, ceiling, and floor areas shall be equivalent to or provided with applicable protective barriers as required in Paragraph F.5 (b)(1) and (2).

(c) Operating Procedures.

(1) The operator shall stand well away from the useful beam and the animal during radiographic exposures.

(2) Hand-held fluoroscopic screens shall not be used.

(3) No individual other than the operator shall be in the X-ray room while exposures are being made unless such individual's assistance is required.

(4) In any application in which the operator and other assisting individuals are not located behind a protective barrier, a protective apron having a lead equivalent of not less than 0.5 millimeter shall be worn by individuals in the room during exposures.

(5) When an animal must be held in position for an exposure, mechanical supporting or restraining devices shall be used whenever feasible. If the animal must be held by an

individual that individual shall be adequately protected and he shall be positioned so that no part of his body except hands and arms will be struck by the useful beam and that his body is as far as possible from the edge of the useful beam. The exposure of any individual used for this purpose shall be monitored.

PART F

USE OF SEALED RADIOACTIVE SOURCES IN THE HEALING ARTS

Sec. F.1 Scope. The provisions of this part apply to all licensees who use sealed sources in the healing arts and are in addition to, and not in substitution for, other applicable provisions of these regulations.

Sec. F.2 Interstitial, Intracavitary and Superficial Applications.

(a) Accountability, Storage and Transit.

(1) Except as otherwise specifically authorized by the Agency, each licensee shall provide accountability of sealed sources and shall keep a permanent record of the issue and return of all sealed sources.

(2) When not in use, sealed sources and applicators containing sealed sources shall be kept in a protective enclosure of such material and wall thickness as may be necessary to assure compliance with the provisions of Sections C.101, C.104, and C.105.

(b) Testing Sealed Sources for Leakage and Contamination.

(1) The licensee shall provide for testing for contamination prior to initial use. All sealed sources shall be tested for leakage at least every six (6) months. If there is reason to suspect that a sealed source might have been damaged, it shall be tested for leakage before further use.

(2) Leak tests shall be capable of detecting the presence of 0.005 microcurie of removable contamination on the sealed source. Any test conducted pursuant to Section F.2(b)(1) which reveals the presence of 0.005 microcurie or more of removable contamination shall be considered evidence that the sealed source is leaking. The licensee shall immediately withdraw the source from use and shall cause it to be decontaminated and repaired or to be disposed of in accordance with applicable provisions of Part B.

Sec. F.3 Teletherapy.

(a) Equipment.

(1) The housing shall be so constructed that, at one (1) meter from the source, the maximum exposure rate does not exceed ten (10) milliroentgens per hour when the beam control mechanism is in the "off" position. The average exposure rate measured at a representative nuber of points about the housing, each one (1) meter from the source, shall not exceed two (2) milliroentgens per hour.

(2) For teletherapy equipment installed after the effective date of these regulations, the leakage radiation measured at one (1) meter from the source when the beam control mechanism is in the "on" position shall not exceed one (1) roentgen per hour or 0.1 percent of the useful beam exposure rate.

(3) Adjustable or removable beam-defining diaphragms shall allow transmission of not more than five (5) percent of the useful beam exposure rate.

(4) The beam control mechanism shall be of a positive design capable of acting in any position of the housing. In addition to an automatic closing device, the mechanism shall be designed so that it can be manually returned to the "off" position with a minimum risk of exposure.

(5) The closing device shall be so designed as to return automatically to the "off" position in the event of any breakdown or interruption of the activating force and shall stay in the "off" position until activated from the control panel.

(6) When any door to the treatment room is opened, the beam control mechanism shall automatically and rapidly restore the unit to the "off" position and cause it to remain there until the unit is reactivated from the control panel.

(7) There shall be at the housing and at the control panel a warning device that plainly indicates whether the beam is on or off.

(8) The equipment shall be provided with a locking device to prevent unauthorized use.

(9) The control panel shall be provided with a timer that automatically terminates the exposure after a preset time.

(10) Teletherapy sources shall be tested for leakage and contamination in accordance with the procedures described in Section F.2(b) except that the leak tests shall be capable of detecting 0.05 microcurie of removable contamination, and a source shall be considered to be leaking if the test reveals the presence of 0.05 microcurie or more of removable contamination.

(b) Shielding.

(1) Primary protective barriers shall be provided for any area that the useful beam may strike when using the largest possible diaphragm opening. Such barriers should extend at least one (1) foot beyond the useful beam for any possible orientation.

(2) Secondary protective barriers shall be provided for all occupied areas exposed to leakage and scattered radiation.

(3) Provision shall be made to permit continuous observation of patients during irradiation.

(c) Operation. No individual who is occupationally exposed to radiation shall be in the treatment room during irradiation unless he is the patient. No other individual shall be there except when it is clinically necessary.

(d) Inspections. The provisions of Section F.2(b) shall apply except that tests of leakage may be made by wiping accessible surfaces of the housing port or collimator while the source is in the "off" position and measuring these wipes for transferred contamination.